~~SECRET~~

INSERT CLASSIFICATION (IF CLASSIFIED)

2862

USE WHERE REQUIRED

U. S. ATOMIC ENERGY COMMISSION

OUTGOING TELECOMMUNICATION MESSAGE

(See reverse side for instructions)

THIS DOCUMENT CONSISTS OF 2 PAGES
NO. 1 OF 7 COPIES, SERIES A

DATE OF MESSAGE
MARCH 19, 1962

S. R. SAPIRIE
MANAGER
OAK RIDGE OPERATIONS

OFFICIAL BUSINESS
E M Wende
for S.R. Sapirie (Signature of certifying official)

PRECEDENCE DESIGNATION | ENCIPHERED BY

US AEC
WASHINGTON 25, D. C.

FOR: DR. N. H. WOODRUFF, DIRECTOR
DIVISION OF OPERATIONAL SAFETY

INFO/C.A. NELSON, DIV. OF INSPECTION
D.C. CLARK, DIV. OF PUBLIC INFO.
D.E. GEORGE, DIV. OF NMM
F.P. BARANOWSKI, DIV. OF PRODUCTION
J.A. WATERS, JR., DIV. OF SECURITY
US AEC, WASHINGTON, D. C.

IFICATION RECOMMENDED
E. T. Keyes FEASI
DC) - Organization
28-96

PERMANENT Document
Indefinite retention period

INITIAL REPORT OF RELEASE OF PROCESS GAS AT 10:45 P.M., FRIDAY, MARCH 16 IN K-1420 RECOVERY AREA, ORGDP. RELEASE INVOLVED MATERIAL ENRICHED TO 38.5 WT. PERCENT 235 AND WAS COMPLETELY CONTAINED IN THE HOUSING THAT SURROUNDS THE RECOVERY FLUORINATION TOWER. THERE WAS NO RELEASE TO THE GENERAL ATMOSPHERE NOR TO THE K-1420 BUILDING ITSELF. NO PERSONNEL EXPOSURES RESULTED FROM THE MISHAP. THERE WAS NO SIGNIFICANT DAMAGE TO EQUIPMENT OR STRUCTURES. PARA

DECONTAMINATION OF THE FIFTEEN FEET SQUARE BY FORTY FEET HIGH ENCLOSURE IS NOT YET COMPLETED. PRELIMINARY ESTIMATES ARE THAT THERE MAY BE A LOSS OF A MAXIMUM OF SEVEN KILOGRAMS OF URANIUM AT APPROXIMATELY 38.5 WT PERCENT U-235, VALUED AT $31,000. A CONSIDERABLE AMOUNT OF CONTAMINATED MATERIAL HAS NOT BEEN EVALUATED AS YET. PARA

WHEN RECOVERY AND DECONTAMINATION OPERATIONS ARE COMPLETED AND CHEMICAL

DATE

FRATERIALS S-3

Rec'd by W.L.E. at 19/2215

Encoded by DJL at 20/145

shall:ag

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S-228		

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Sent by W.L.E. at 20/152

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ORO 113.806

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U. S. ATOMIC ENERGY COMMISSION

OUTGOING TELECOMMUNICATION MESSAGE—CONTINUATION

NALYSES ARE AVAILABLE SOMETIME NEAR THE END OF THIS WEEK, IT IS EXPECTED HAT THE LOSS WILL BE LESS; PROBABLY IN THE NEIGHBORHOOD OF 2 TO 3 KILOGRAMS R ABOUT $15,000 OR LESS. PARA

HE MISHAP OCCURRED DURING SHUT-DOWN OPERATIONS PREPARATORY TO MAINTENANCE ORK ON THE TOWER. ONE SET OF COLD TRAPS WAS BEING USED TO REMOVE HEX FROM HE NITROGEN PURGE GAS FLOWING THROUGH THE TOWER. THE OTHER ADJACENT COLD RAP HAD BEEN FILLED WITH APPROXIMATELY 90 POUNDS OF HEX AND WAS IN THE EATING CYCLE JUST PRIOR TO DRAINING INTO FIVE INCH CYLINDERS. PARA

OR REASONS AS YET UNKNOWN, A CROSS-OVER VALVE CONNECTING THE TWO SETS F COLD TRAPS FAILED. THE MOLTEN HEX SURGED INTO THE INLET END OF THE OLD TRAP THAT WAS IN USE AND THEN BACK INTO THE TOWER. THE PRESSURE URGE IN THE TOWER RUPTURED A BELLOWS AT THE DISCHARGE END OF THE OXIDE FEED HOPPER AT THE TOP OF THE TOWER AND ALLOWED HEX TO ESCAPE INTO THE CUBICLE THAT SURROUNDS THE TOWER. THE SURGE ALSO BLEW ABOUT 150 POUNDS OF BLACK OXIDE OUT OF THE FEED HOPPER ONTO THE PLATFORM WHICH WAS UNOCCUPIED AT THE TIME AND IS ALSO INSIDE THE CUBICLE. PARA

THE ACOUSTIC GAS ANALYZERS AND OTHER DETECTORS ON ALL OF THE POSSIBLE POINTS OF DISCHARGE TO THE ATMOSPHERE INDICATE NO HEX ESCAPED TO THE REMAINDER OF THE K-1420 BUILDING OR TO THE ATMOSPHERE. SMEAR TESTS HAVE CONFIRMED THIS COMPLETE LACK OF CONTAMINATION OUTSIDE OF THE CUBICLE. PARA

E HAVE(~~EE~~ REPORTED THIS(~~MISHAP~~) TO THE LOCAL OFFICE OF THE FBI AS AN OPERATIONAL MISHAP PARA

UR INVESTIGATION OF THIS INCIDENT WILL CONTINUE AND WE WILL INFORM YOU OF ANY EVELOPMENTS AND THE RESULTS OF THE COMPLETED DECONTAMINATION OPERATIONS.

ND REF OPA:EDM

C: R. C. Armstrong

☆ GPO : 1952—O-996790

INVENTORY DATE: _____

PAGE COUNT: 2

INITIAL: _____

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2863

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Jerry E. Keyes EASI
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3-28-96
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THIS DOCUMENT CONSISTS OF 22 PAGES
NO. 1 OF 4 SERIES B

PAGE ONE OF TWO PAGES

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FM USAEC ORO OAK RIDGE TENN

S R SAPIRIE

DECLASSIFICATION AUTHORIZER
GABRIEL MARCIANTE, ORO CLASSIFICATION OFFICER
NAME (ADD) - ORGANIZATION
3/29/96
DATE

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INFO CY E J BLOCH

J A WATERS

D F MUSSER

cy 1A-destroyed

* 067920A 001 *

1987-1673

NR S-336 MAR 111515Z GR 328

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REPORT OF UNUSUAL INVOLVING SS MATERIAL. (U)

PART I -

AT 4.10 PM ON MARCH 10 1955, THE VALVE BODY ON A 450 POUND UF SIX CYLINDER RUPTURED WHILE BEING VAPORIZED INTO THE CASCADE AT THE K-33 VAPORIZATION AREA. IT IS ESTIMATED THAT A MAXIMUM OF 70 POUNDS UF SIX WAS RELEASED TO THE ATMOSPHERE. NO ONE WAS INJURED. VAPORIZATION AREA WAS TEMPORARILY EVACUATED UNTIL RELEASE WAS BROUGHT UNDER CONTROL.

PART II -

AT 10.40 PM ON MARCH 10 1955, ANOTHER 450 POUND UF SIX CYLINDER RUPTURED WHILE LOCATED IN THE K-33 VAPORIZATION AREA. THE VAPORIZATION OF THIS CYLINDER HAD BEEN DISCONTINUED WHEN THE FIRST CYLINDER VALVE RUPTURED AND THE CYLINDER WAS COOLING DOWN WHEN IT RUPTURED. CAUSE OF RUPTURE NOT YET DETERMINED. IT IS ESTIMATED THAT A MAXIMUM OF 400

REBc

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A SHORT PERIOD UNTIL THE EXTENT OF THE RELEASE COULD BE ESTABLISHED. BY MID-NIGHT THE CONTAMINATED AREA IN THE VAPORIZATION AREA WAS ROPED OFF, MARKED AND CLEANUP OPERATIONS STARTED. PARA THE CYLINDERS INVOLVED IN BOTH INCIDENTS HAD BEEN IN THE PLANT AREA FOR SOME TIME. EXACT HISTORY OF THE MATERIAL IS BEING CHECKED. BELIEVED TO BE MATERIAL REMOVED FROM 20-STAGE PILOT PLANT SOME TIME AGO. PARA

PROPERTY DAMAGE FOR BOTH INCIDENTS ESTIMATED TO BE $3,000 TO $4,000. TOTAL COST INCLUDING PROPERTY DAMAGE, MATERIAL LOSS AND DECONTAMINATION ESTIMATED AT $10,000. DURING THE 12 TO 8 SHIFT ADEQUATE DECONTAMINATION HAD BEEN ACCOMPLISHED TO ALLOW THE RESUMPTION OF FEED TO THE CASCADE. PARA

BOTH INCIDENTS ARE BEING INVESTIGATED AND REPORT OF RESULTS WILL BE FURNISHED YOU. PARA

BOTH INCIDENTS ARE BEING REPORTED TO THE F.B.I FOR INFORMATION BUT NO REQUEST FOR INVESTIGATION IS BEING MADE END REF OP RCA 336

END OF MESSAGE

MAR 55 112019Z PCH

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~~CONFIDENTIAL~~
~~SECURITY INFORMATION~~

2864

R. W. Cook, Director of Production
Washington

March 16, 1953

S. R. Sapirie, Manager
Oak Ridge

REPORT OF RELEASE OF K-25 PROCESS MATERIALS

SYMBOL: OPA:VVH

K-12302

Reference is made to the Oak Ridge Operation's Weekly Activity Report for the week ending January 9, 1953.

In accordance with the provision of CM-SEC-3 we are enclosing herewith a report of an accident which occurred December 30, 1952, involving the loss of process gas to the atmosphere. The uranium lost as a result of this accident was nominal normal uranium. The contractor has taken certain precautionary steps in an attempt to prevent re-occurrence of this type of incident.

for S. R. Sapirie

Enclosure:
Report

CC: N. H. Woodruff, w/o encl.

Hendrix:rg

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ATERIALS 9K-25

OFFICE ▶	Prod Div	R.D. Div	Dir	Opns O		
NAME ▶	Hendrix			Dowling for Sapirie		ORO 29623
DATE ▶	3-13-53			3/12/53		

m AEC-318 U. S. GOVERNMENT PRINTING OFFICE 16—62761-2

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2865

CARBIDE AND CARBON CHEMICALS COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

UCC

POST OFFICE BOX P
OAK RIDGE, TENNESSEE

February 16, 1953

K-12303

United States Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

Attention: Mr. Ray C. Armstrong, Director, Production Division

Gentlemen:

Report of Release of K-25 Process Materials

The attached report of the formal investigation of a serious incident involving the release of K-25 process materials has been prepared in accord with our obligations to investigate and report such incidents as specified in Bulletin CR-SFP-5 (Serial No. 88). The actions which have already been taken and those which are proposed for completion appear to encompass major practicable precautions against the future occurrence of similar incidents.

Very truly yours,

CARBIDE AND CARBON CHEMICALS COMPANY

A. P. Huber

A. P. Huber, K-25 Plant Superintendent

DECLASSIFICATION RECOMMENDED
Name (ADC) Organization
3-28-96
Date

HFH:mrh

Attachment

cc: Mr. C. E. Center
Mr. W. B. Humes
Mr. W. L. Richardson
Mr. M. F. Schwenn
Safety Department K25RC

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ORO 29234

INVESTIGATING COMMITTEE REPORT

OF SERIOUS INCIDENT

INVOLVING RELEASE OF K-25 PROCESS MATERIALS

KS-355

Description of Damaged Property: Valve of 1-Ton Chlorine Cylinder.

Amount of UF_6 Released to Atmosphere: Approximately 2,506 lb. of depleted UF_6.

Time of Incident: 12:30 p.m., December 30, 1952.

Location of Incident: Feed Baths on Cell Floor, Building K-402-1, Carbide and Carbon Chemicals Company, K-25 Plant, Oak Ridge, Tennessee.

Description of Incident: While opening the valve of a heated feed cylinder preparatory to sampling the cylinder contents, an operator noted the escape of material from the valve and attempted to close it. As he did so, the valve stem shot out of its bonnet and a cloud of UF_6 emerged from the cylinder. The K-27 buildings were evacuated and the release was finally brought under control by removing the cylinder from the bath and freezing its contents with dry ice.

Findings:

1. This particular cylinder had been filled at Paducah and shipped to K-25.
2. The events leading up to the release were as follows:
   a. The cylinder was placed in the feed bath at 5:00 p.m., on December 29, 1952.
   b. At 12:20 p.m., December 30, 1952, the sampling manifold was connected to the cylinder valve; the manifold was warmed until 12:30 p.m. when the cylinder valve was opened by an operator who was the only employee in the immediate vicinity of the cylinder.
   c. The operator reported that when he had opened the valve about 1/4-turn, he noted UF_6 escaping so he immediately closed it. Since the gas continued to escape, however, he was attempting to close the valve more tightly when its stem shot out with such force that his arm and the wrench he was holding were violently pushed aside.
3. The Area I office and the Central Control Room were immediately notified of the release; evacuation of K-27 personnel was directed over the public address system.

DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW
Determination [Circle Number(s)]
1. Classification Retained
2. Classification Changed To:
3. Contains No DOE Classified Information
4. Coordinate With:
5. Classification Cancelled
6. Classified Information Bracketed
7. Other (Specify):
1st Review - Date: 4/23/96 ☒ ADC ☐ ADD
Authority:
Name:
2nd Review - Date: 4-23-96
Authority: ADD
Name: Malcolm Phillips

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4. The steam supply to the K-27 feed baths was shut off so that continued heating of the cylinders in the bath would cease; in order to accomplish this, it was also necessary to shut off the steam supply to K-1131.
5. The ventilating fans in the basement of K-402-1 were stopped.
6. Attempts to freeze down the cylinder with CO_2 from 50-lb. extinguishers were unsuccessful.
7. The cylinder was removed from its bath with a Hyster and brought outside the building where the valve hole was plugged and its contents finally frozen with CO_2 ice.
8. All employees required to enter the UF_6 fog for operation or observation during the release were equipped with either a Chemox gas mask or an Army Assault mask.
9. Employees involved in the incident were sent to the dispensary for supervisory checks and returned to normal work.
10. Approximately 2,506 lb. of material escaped from the cylinder; only about 300 lb. was retained.
11. Investigation showed that the accident was the direct result of the fracture of the union nut on the valve bonnet; evidence indicated that this nut had previously cracked under strain and that this specific failure came as a result of the completion of the crack. (See figure 1.) It appeared that when the valve was opened, the UF_6 escaped through the cracked nut; the act of closing the valve tightly put sufficient additional strain upon the nut that it split apart.
12. Metallurgical study indicated that the failure of this nut was caused by the selective attack of cylinder gases upon one phase of this binary alloy. This attack probably was accelerated by the high metal stresses in the metal, Duronze III.
13. In use, the nut had to be torqued sufficiently to provide a gas-tight metal-to-metal seal between the valve body and the bonnet, both of the same material. This frequently required a high torque and consequent overstressing of the nut.
14. A spot check of similar union nuts both at K-25 and at Paducah disclosed that cracks had already started in several of them.
15. The valve was a stock design of the manufacturer who claimed that no similar trouble had previously been encountered.
16. The valves originally installed in these cylinders were 3/4" 1-piece valves which did not require the union nut. However, when operations required the use of 1" valves, the low-bid unit which was accepted was the present 2-piece valve.

Conclusions:

The committee considered the primary cause of the incident to be inherent in the design and construction of the valve in that overstressing of the valve components was frequently necessary to make gas-tight seals; no torque limitations on valve closure had been specified by the manufacturer.

Recommendations:

As a result of recommendations made by the committee investigating this incident, the actions outlined below have either been taken or are planned in order that the possibility of a future occurrence of this type will be reduced as far as is practicable.

Actions Taken to Prevent Future Incidents:

1. As a temporary measure, the present union nuts which are of Duronze III material will be replaced with plated steel nuts.
2. A 1/32" thick P-10 gasket will be used to effect the seal between the valve body and the bonnet in all cases where these valves are used. In an effort to develop a satisfactory metal gasket to replace the P-10 material, a program of metal testing has been initiated.
3. Torque limitations on valve closure have been established for both the union nut and the stem.
4. More adequate supplies of CO_2 are being maintained in those locations where gaseous or liquid UF_6 under pressure is maintained.

Remaining Action to be Taken to Correct Condition:

1. All 2-piece valves on cylinders to be used for inter-plant shipments will be eventually replaced by 1-piece valves.
2. Until these 2-piece valves are replaced, metal gaskets will be used for the seal when successful units are developed.

INVESTIGATING COMMITTEE

R H Dyer

R. H. Dyer, Chairman,
Area I Supervisor,
Production Division

R. D. Shaffer

R. D. Shaffer, Member,
Operations Engineering Supervisor
Production Division

Hugh F. Henry

H. F. Henry, Member,
Safety and Radiation Hazards Dept. Hea
Safety and Protection Division

H. F. Henry:lja
February 10, 1953

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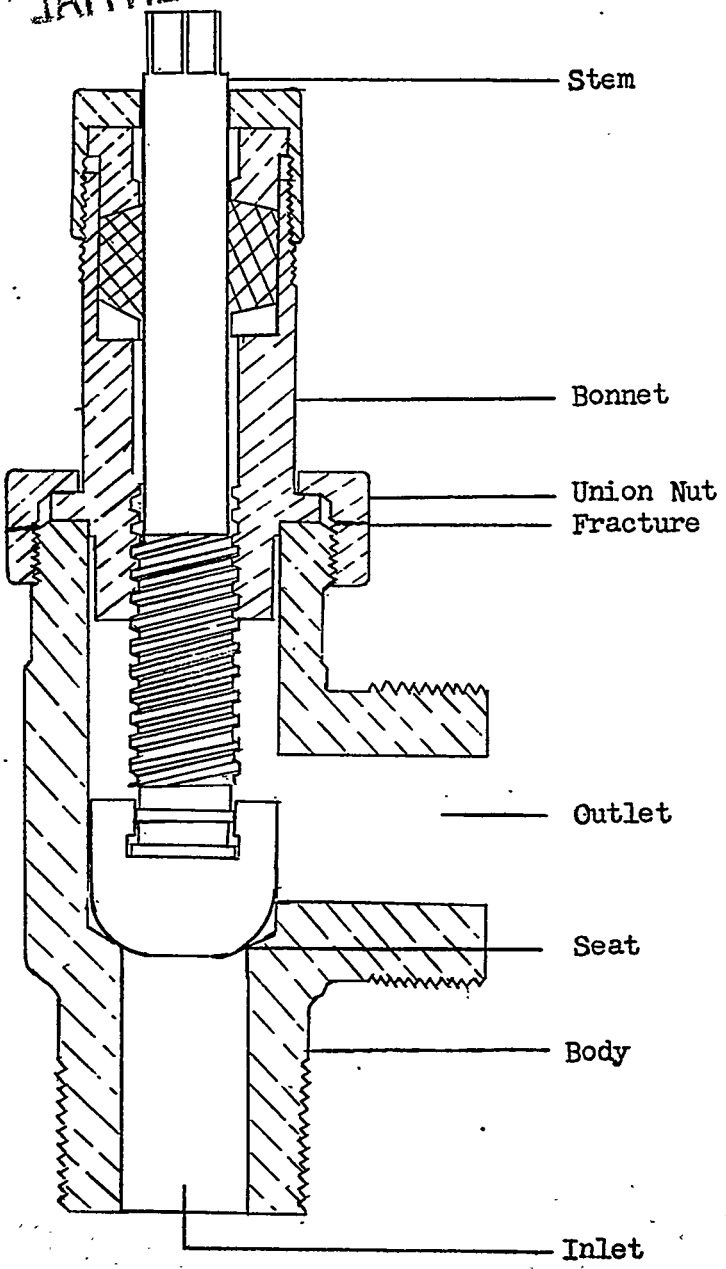

Figure 1

Angle Type - Gas Drum Valve

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2867 Winsel 4
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CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

UCC

POST OFFICE BOX P
OAK RIDGE, TENNESSEE

March 18, 1955

United States Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

Attention: Mr. Ray C. Armstrong, Director, Production Division

Gentlemen:

Report of Explosion at K-25

The attached report of the formal investigation of an explosion occurring while a cylinder was being heated to feed its contents to the K-25 cascade has been prepared in accordance with Bulletin OR-SFP-5 (Serial No. 88). The investigating committee was composed of H. G. P. Snyder, J. A. Parsons, and L. L. Anthony of the Production Division, E. C. Johnson of the Technical Division, and H. F. Henry of the Safety and Protection Division. Action is being taken upon the recommendations of the committee which appears to encompass the major practicable steps for the prevention of a similar incident in the future.

Very truly yours,

CARBIDE AND CARBON CHEMICALS COMPANY

A. P. Huber

A. P. Huber, K-25 Plant Superintendent

HFH:mh:ved

Attachment OR-2

cc: Mr. C. E. Center
Mr. L. B. Emlet
Mr. W. L. Richardson
Mr. M. F. Schwenn
Safety Department - K25RC

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Jerry E. Kezar EASI
3-28-96

REBc

INVESTIGATING COMMITTEE REPORT

OF AN EXPLOSION AT K-25

KS-478

Description of Damaged Property: One feed furnace, demolished.
Minor damage to another feed furnace.
Two platform scales heavily damaged.
One 12" I.D. x 40" feed cylinder destroyed.
Miscellaneous damage to lighting system.

Extent of Damage to Government Property: $5800

Amount of Material Released: * 547 lb. of normal UF_6 maximum; of this, it is estimated that over 100 lb. will be recovered.

Value of Materials Lost: * $5000

Time of Incident: 10:40 P.M., March 10, 1955

Location of Incident: Feed Vaporization Room in Building K-902-5, Carbide and Carbon Chemicals Company, K-25 Plant, Oak Ridge, Tennessee

Description of Incident:

While a partially emptied cylinder from which UF_6 had been fed to the cascade was cooling down, it violently exploded without warning, severely damaging nearby equipment and releasing its contents to the atmosphere. Although there were 5 employees in the room at the time of the explosion, none were injured in any way, either by flying debris or by the UF_6 released. A previous release of material from a similar cylinder in another furnace had occurred at 4:03 P.M. of the same day in the same room when a connection suddenly ruptured during the normal feeding cycle.

Findings:

1. Both the cylinder which exploded and the one from which a material release had occurred earlier had been placed in the vaporization furnaces earlier in the day, and, after normal handling, were valved into the cascade for feeding to the cascade at about 2:00 P.M. during the afternoon.

2. As a result of the material release which occurred at 4:03 P.M. and which was quickly brought under control by the use of dry ice, it was decided to turn off the furnaces, allow the second cylinder to cool down, and then to remove it from the feed bath; however,

* These figures apply both to this particular release and a previous release described in the report.

the cylinder connection to the cascade was left open while it was cooling. Thus, when this cylinder exploded, it had been cooling and venting for over 5 hours.

3. At the time of the explosion, the building operator was in the feed room along with 4 other employees who were cleaning up the area contaminated by the earlier release. No one recalls any suspicious circumstance which would have led him to believe the feed operation was abnormal in any way prior to the explosion.

4. None of the employees were struck by debris, and, despite the heavy yellowish "fog" which almost immediately filled the room, all quickly left the room.

5. The violence of the explosion is indicated by the photographs attached. No. 1 shows the feed bath shortly after the explosion where a similar undamaged one may be noted at the side of the photograph. No. 2 shows the remains of the cylinder compared to a similar undamaged one.

6. Pertinent items in the history of the cylinder are as follows:

   a. Both this cylinder and the one from which the earlier material release had occurred were units of a group of 33 similar cylinders from the K-1401 Barrier Pilot Plant, one of which had exploded on May 25, 1953, after 10 had been successfully emptied. (See KS-379, attached to a letter from Mr. A. P. Huber to Mr. R. C. Armstrong dated June 24, 1953.)

   b. Since the previous incident, all of these cylinders had been stored pending a final decision on the disposition of the group.

   c. As a result of a decision to reduce the inventory of stored UF_6 (approximately 300 cylinders) in the plant, the 2 cylinders concerned were inadvertently included in the group which was selected for emptying.

   d. Although adequate records of cylinder history were maintained, these records were not traced beyond the past year, and the significance of this pair of cylinders escaped detection.

   e. The potential hazards inherent in handling cylinders of this group were not identified except by the SF transfer record noted above.

7. Since it has been suspected that the previous explosion of May 25, 1953, was the result of hydrocarbon oil being mixed with the UF_6, experiments had been initiated to indicate the explosivity of such mixtures, and these had indicated that they would explode at temperatures in the range of 70° - 90°C. At the time of this explosion, it is estimated that at least some of the contents of the cylinder were probably well within this range.

8. As a result of the previous incident, the following steps had been taken in accord with the recommendations of the investigating committee and their later modifications:

   a. Standard Reference Information had been prepared and distributed on practically all of the potentially hazardous chemicals at K-25.

   b. A barricaded facility had been provided for UF_6 transfer operations; however, the committee doubts if the present facility would have withstood an explosion as violent as the one involved in this instance.

   c. A review of vacuum pumps used in UF_6 transfer systems was made and, where practicable, fluorocarbon oil was specified for use in those not already using it.

   d. The cylinders immediately concerned in the original explosion were removed to a separate storage location; however, as indicated above, they were not so marked that immediate identification of their hazards would be possible.

Conclusions:

Although the results of the explosion made positive identification of its cause difficult, it was the rather definite opinion of the committee that it did result from hydrocarbon oil having gotten into the cylinder of UF_6 during its usage in the K-1401 Barrier Pilot Plant.

Recommendations:

In addition to continued follow-up on the recommendations made at the time of the previous incident, the investigating committee suggests that:

1. A more positive method for immediate identification of container contents with specific attention given to potentially hazardous materials be developed and employed.

2. Pending a laboratory investigation to develop a method of safely disposing of cylinders from the involved facility, the subject cylinders should be segregated and individually identified until the ultimate method of disposal can be formulated.

3. It is recommended that a review be made of the adequacy of the existing sampling facility to determine whether the present barricades can be strengthened to provide adequate personnel protection in the event of an incident similar to this one.

4. Additional experimental investigation of the explosive properties of materials fed to the K-25 cascade be made where the advisability of such action is indicated.

H. F. Henry:mh:ved
3-18-55

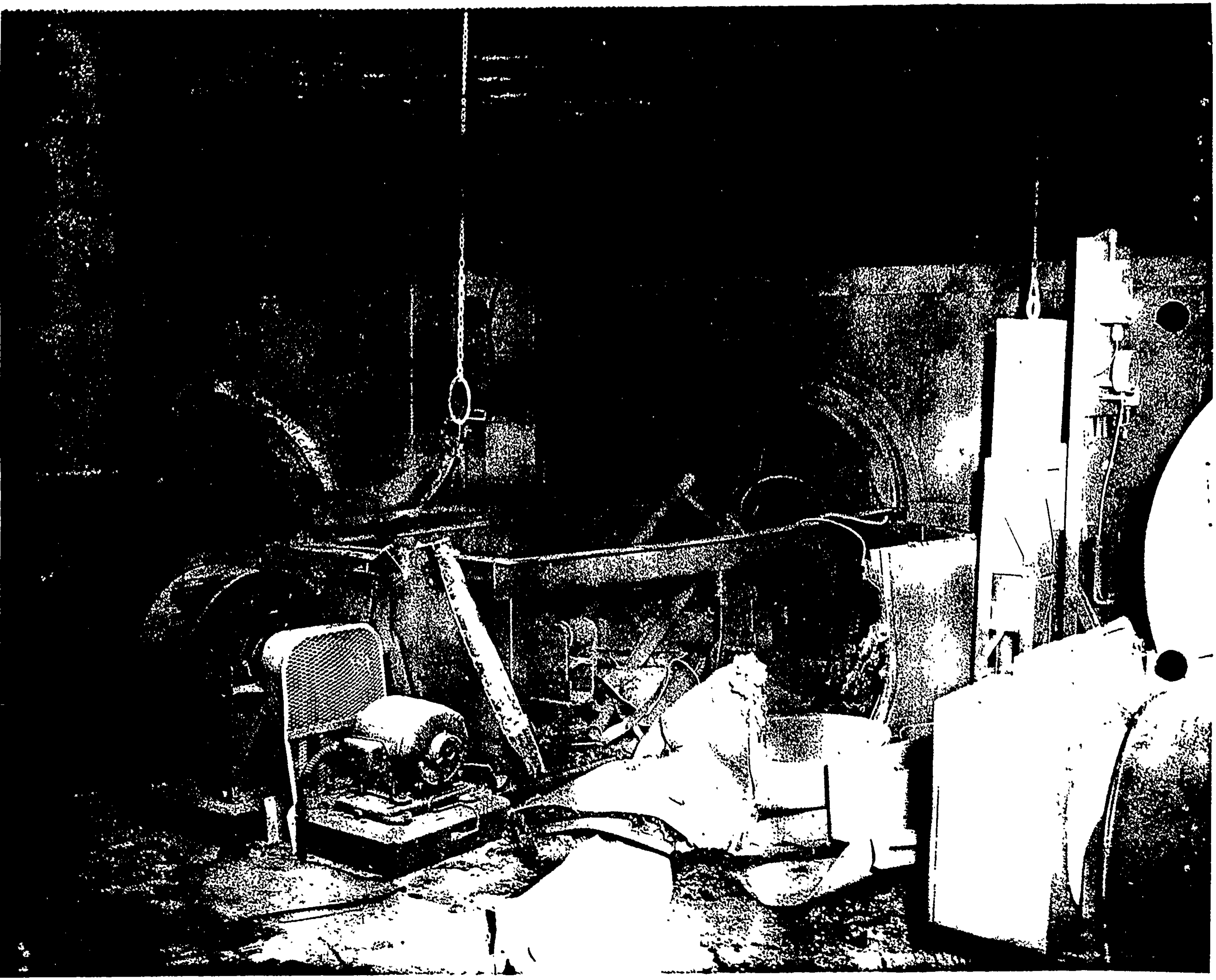
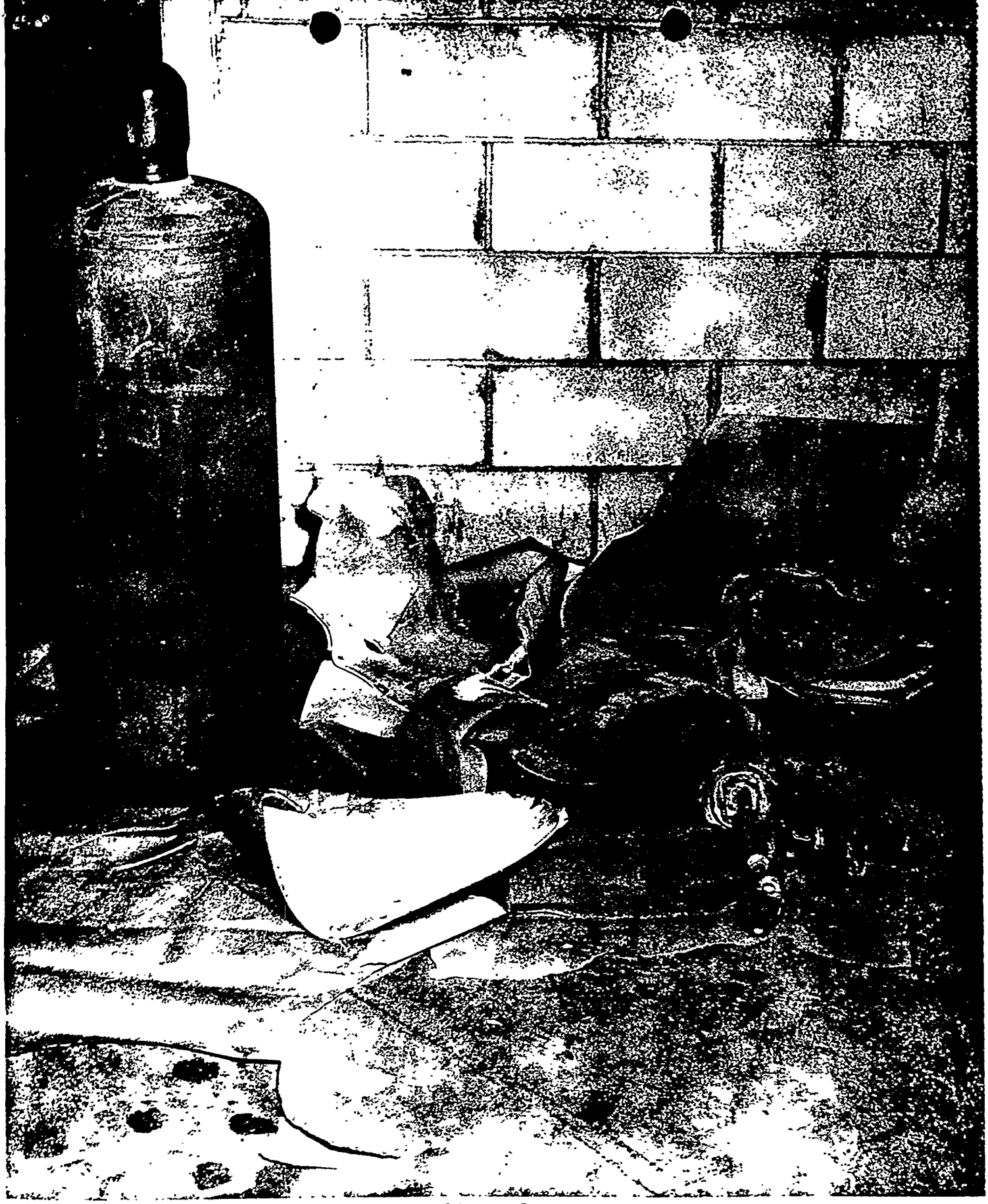


Figure 1



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KB-588

RHTG # 63,313
BOX # 2662

INFORMATION DESIRED BY

1. Isotopic Concentrations

Isotopic assays for inventory samples at various points in the profiles of the gaseous diffusion cascades and for certain specified feed materials are presented in table I.

TABLE I

ISOTOPIC CONCENTRATIONS

Material	Date	Composition and 95% Confidence Limits, Percent U-234	U-235	U-236	CL, 234	CL, 235	CL, 236
ORGD Tails	4-1-56	0.0025	0.250	0.007	±0.0005	±0.0006	±0.001
Paducah Tails	4-1-56	0.00049	0.1431	0.0030	±0.00004	±0.0004	±0.0002
Paducah Product	4-4-56	0.0041	0.7136	0.0078	±0.0002	±0.0014	±0.0006
SR Reactor Tails (1)	4-17-56	0.0049	0.6705	0.0072	±0.0005	±0.0016	±0.0005
Hanford Reactor Tails (2)	4-3-56	0.0051	0.6822	0.0054	±0.0003	±0.0014	±0.0003

(1) Sample of hexafluoride produced in the Oak Ridge Gaseous Diffusion Plant Works Laboratory from a batch of Savannah River reactor tails on the date indicated.

(2) Sample of hexafluoride produced in Paducah feed plant from batch of Hanford reactor tails on date indicated.

2. Uranium in Effluents from the Oak Ridge and Paducah Gaseous Diffusion Plants

The estimated quantities of uranium in effluents from the Oak Ridge and Paducah Gaseous Diffusion Plants are shown in tables II and III, respectively.

3. Three-Plant Gaseous Diffusion Inventory

Inventory information for the cascades and permanently attached auxiliary vessels of the three gaseous diffusion plants as of March 1, 1956 is submitted in table IV.

DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW
Date: 5-21-96
Determination [Circle Number(s)]
1. Classification Retained
2. Classification Changed To: Confidential RD
3. Contains No DOE Classified Information
4. Coordinate With:
5. Classification Cancelled
6. Classified Information Bracketed
7. Other (Specify):

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TABLE II

ESTIMATES OF URANIUM IN EFFLUENTS FROM THE ORGD PLANT

Source	Period	U, Kg.	Basis for Estimate	Assay Range, Percent U-234	Assay Range, Percent U-235	Assay Range, Percent U-236
CASCADE OPERATIONS:						
Cylinder Disconnections	To date	0.5/yr.	Recovery from test pigtails	0.0025 to 2.10	0.2 to 93.2	0.0 to 0.340
Vents thru Cold and Alumina Traps	To date	3.0/yr.	Mechanical trap recoveries	0.0025 to 0.35	0.2 to 50.0	0.0 to 0.350
Vents from Purge Cascade	To date	nil	Space recorders before alumina traps	--	--	--
FEED PLANT OPERATIONS:						
To Storm Sewer (1)	To 1955	5100, total	Survey of Poplar Creek bed	0.0051	0.66 to 0.71	0.0 to 0.0054
Stack Losses	1951 and 1952	5800, total	Flow rates and periodic samples	0.0051	0.66 to 0.71	0.0 to 0.0054
Stack Losses	1953 thru 1955	1150, total	Flow rates and periodic samples	0.0051	0.66 to 0.71	0.0 to 0.0054
Drum Washer Waste	To date	nil	Recovered from settling pond (1)	--	--	--
DECONTAMINATION OPERATIONS:						
Evaporator Condensate and Waste Acid (2)	To July 1955	0.25/mo.	Volumes and analyses	0.0025 to 2.10	0.2 to 93.2	0.0 to 0.340
Evaporator Condensate and Waste Acid (2)	July 1955 to date	0.025/mo.	Volumes and analyses	0.0025 to 2.10	0.2 to 93.2	0.0 to 0.340
Equipment Rinse Carry-over (2)	To July 1955	0.15/mo.	Volumes and analyses	0.0025 to 2.10	0.2 to 93.2	0.0 to 0.340
Equipment Rinse Carry-over (2)	July 1955 to date	4.0/mo.	Volumes and analyses	0.0025 to 2.10	0.2 to 93.2	0.0 to 0.340
Laundering Clothing (1)	To July 1955	2/yr.	Sewage plant sludge volumes and analyses	0.0025 to 2.10	0.2 to 93.2	0.0 to 0.340
MATERIAL RELEASES:						
From Containers	1951 thru 1955	150/yr. (3)	Inventory accountability	0.0025 to 2.10	0.2 to 93.2 (4)	0.0 to 0.340
Equipment Failures	1951 thru 1955.	80/yr.	Inventory accountability	0.0025 to 2.10	0.2 to 93.2 (5)	0.0 to 0.340
POPLAR CREEK BURDEN: (6)						
At Mouth of East Fork (7)	1954 and 1955	935/yr.	Flow rates and analyses	Not available		
At Mouth of Poplar Creek (8)	1954 and 1955	540/yr.	Flow rates and analyses	Not available		

(1) Water insoluble materials.

(2) Solutions to pond which overflows to Poplar Creek.

(3) Plus 740 kg. of 0.56 percent U-235 material on December 30, 1952.

(4) Experience mean, 0.75.

(5) Experience mean, 0.78.

(6) Water soluble materials.

(7) Not from the Oak Ridge Diffusion Plant.

(8) Undetermined and variable portion of this material from the Oak Ridge Gaseous Diffusion Plant. Small part of this burden represents material not adsorbed on silt in settling pond (2).

TABLE III

ESTIMATES OF MATERIAL LOSSES FROM THE PADUCAH PLANT

Source	Total U, Kg.	Est. Assay or Assay Range, Wt. Percent U-235
FEED PLANT		
Stack losses to atmosphere		
Prior to 3-1-53	0	--
Between 3-1-53 and 3-1-56 (1)	7,020	ca. 0.68
Material releases to atmosphere		
Prior to 3-1-53	0	--
Between 3-1-53 and 3-1-56 (2)	1,060	ca. 0.68
Creek losses from floor drains, neutralizer pits, etc. (uranyl solutions)		
Prior to 3-1-53	0	--
Between 3-1-53 and 3-1-56 (1)	235	ca. 0.68
DECONTAMINATION OPERATIONS		
Derby pickling losses to atmosphere		
Between 11-1-54 and 7-1-55 (intermittent operation) (4)	3,120	ca. 0.25
Creek losses from holding pond overflow		
Prior to 3-1-53	0	--
Between 3-1-53 and 3-1-56 (3)	1,120	ca. 0.6 to 0.7
CASCADE OPERATIONS		
Vent through cold traps and chemical traps		
Prior to 3-1-53 (5 months) (1)	1	0.7 to 1.2
Between 3-1-53 and 3-1-56 (1)	9	0.7 to 1.2
Breaking cylinder connections		
Prior to 3-1-53	negligible	0.4 to 1.2
Between 3-1-53 and 3-1-56	negligible	0.15 to 1.2
Material releases		
Prior to 3-1-53 (2)	130	0.4 to 1.0
Between 3-1-53 and 3-1-56 (2)	2,250	0.15 to 1.0

(1) Based on measured losses and should be fairly reliable.

(2) Contain some estimates and some measured quantities.

(3) Strictly an estimate and may be off by as much as 100 percent or more.

(4) Calculated by difference and is fairly reliable.

TABLE IV

CASCADE INVENTORY, MARCH 1, 1956

Plant	Uranium, Kg.	Uranium-235, Kg.	Average Assay, Percent U-235
Oak Ridge			2.89
Paducah	334,422	900	0.27
Portsmouth			1.99
TOTAL			1.62

DISCUSSION

This section consists of brief descriptions of the conditions under which effluxes occur and the general nature of the effluents. The narratives are based on operations at Oak Ridge, but those for Paducah would be similar with the exception of the derby pickling operation which is performed at Paducah but not at the Oak Ridge Gaseous Diffusion Plant. This item is treated separately in the descriptive narrative which follows.

Losses at Withdrawal and Feed Points

The equipment for transferring uranium hexafluoride from portable containers into the cascade units, or vice versa, includes flexible hose connectors. After a transfer is made, the flexible hose, which is called a "pigtail",is evacuated and purged with inert gas; however, "smoking" of the pigtail is sometimes visible shortly after it is disconnected from the portable container. The smoking is caused by the evolution of hydrogen fluoride from hydrolysis of uranium hexafluoride adsorbed on the wall of the flexible hose. The loss indicated in table II represents uranium hexafluoride and uranyl fluoride which escape from the pigtails.

Vents through Cold and Alumina Traps

Nonroutine venting of inert gases bearing uranium hexafluoride is performed during preparation of a "negative". The term "negative" is used to describe the condition which a unit of equipment must fulfill before it is considered to be adequately purged and ready for removal from the cascade, namely, that the purge gas in the unit contains less than 10 ppm. of uranium. Negatives are normally prepared before removing equipment units for repair or replacement. The effluents from the cold and alumina traps are discharged into louvered vessels, where hydrolysis of part of the uranium hexafluoride occurs, and uranyl fluoride is recovered. The unreacted uranium hexafluoride and air-borne uranyl fluoride, which escape through the louvers, are indicated as effluents in table II.

Vents From the Purge Cascade

Inert gases accumulating from normal inleakage into the cascades, including seal feed gases, are removed through the purge cascade. The light gases from the purge cascade contain a maximum of 10 ppm. of uranium before being discharged through alumina traps into the atmosphere. The contaminated alumina is replaced frequently with fresh reagent. It is considered that recovery is complete and that there is no effluent uranium from this source.

Losses to the Storm Sewer

In order to maintain cleanliness in the feed plant, uranium compounds are occasionally removed by floor washing operations. The effluent material, primarily uranyl oxide, is discharged to the storm sewer.

Stack Losses From the Feed Plant

Products from the reaction towers, where uranium tetrafluoride is converted to the hexafluoride, consist of uranium hexafluoride, excess fluorine, and hydrogen fluoride. Prior to 1953 this mixture was cooled to -55°F. and condensed in Kellex-type traps. These units incorporated provision for alternate cooling and heating to provide a means for condensing and removing the uranium hexafluoride. The fluorine, hydrogen fluoride and uncondensed uranium hexafluoride were vented from the traps as required to maintain a cold trap pressure not greater than 75 to 100 psia. during the heating phase of the cycle.

Since 1953 Modine or roughing traps, operating at 32°F., have been used to remove the order of 95 percent of the uranium hexafluoride, and the Kellex-type traps, which are situated after the Modine traps, serve as clean-up units. This arrangement has resulted in the substantial reduction in stack losses shown in table II. The effluent material released to the atmosphere is primarily uranium hexafluoride.

One could expect that an increase in radiation in the immediate area of the feed plant would be produced by the effluents, but this effect has not been observed. It is reasoned, then, that the air-borne particles of uranyl fluoride would be quite small. (See also the paragraph Physical Properties of Effluents.)

Losses from Evaporator Condensate, Waste Acid, and Rinse Carry-over

In the decontamination of equipment, 2 percent ammonium carbonate and 3 N. nitric acid are used as recirculated wash solutions on aluminum and nickel-plated steel, respectively. When the recycled solutions attain a uranium concentration of 500 ppm., the uranium is extracted with tributyl phosphate. Recycled solutions from the first water rinses of these lines are also extracted. Fresh water is used for the second rinses and is discharged to a holding pond which overflows to Poplar Creek.

Losses in Laundry Waste

All waste solutions from the laundry are discharged into a baffled concrete pit which overflows into the sanitary sewer. Assays of the solution in the pit on April 12, 1956, indicate 0.058 µg.U per ml. at the surface; 0.050 µg.U per ml., 2-1/2 feet below the surface; and 0.038 µg.U per ml.,at the bottom of the pit. At least part of the suspended insoluble burden is recovered from sewage plant sludge. The soluble uranium content and any residual suspended insoluble materials are discharged from the sewage plant into Poplar Creek and become part of the Poplar Creek burden shown in table II.

Material Releases

Materials lost from containers are largely acid solutions, e.g., uranyl nitrate, which have corroded through the walls of the vessel. The unrecovered material soaks into the ground or becomes dry and is carried away as dust.

The item recorded in footnote (3) of table II was lost as the result of the failure of a valve on a portable container. The material escaped as uranium hexafluoride which would be hydrolyzed to uranyl fluoride in the moist atmosphere.

Losses of liquid uranium hexafluoride through ruptures produced by hydraulic pressure and by explosion of hydrocarbons have occurred, but these are isolated cases. Material releases resulting from equipment failures are mostly at feed and withdrawal stations, or at points where provision is made for rapid change of equipment units such as pumps. These losses consist of uranium hexafluoride escaping to the atmosphere.

Losses from Derby Pickling Operation

At Paducah it was found necessary to pickle metal pieces, called derbies, before remelting the material to cast ingots. The loss sustained in this operation, as indicated in table III, was in the form of acid solution, removed from the working area through the ventilating system and consisted of liquid particles entrained in the air and discharged into the atmosphere.

Integrated Estimates

The total effluents at the Oak Ridge Gaseous Diffusion Plant are estimated to be 7,000 kg.U for the past three-year period and the order of 15,000 kg.U for the entire period of operation of the Oak Ridge Gaseous Plant. It is considered quite possible, however, that the total effluents for the entire period could be as much as three times the value given. The total effluents from Paducah for the three-year period ending March 1, 1956 are estimated to be the order of 15,000 kg.U.

Physical Properties of Effluents

Laboratory studies of the products formed when uranium hexafluoride is released to the atmosphere indicate that the air-borne effluent particles would be of the submicron size, with a probable predominance of particles 400 to 2,000 angstrom units in characterizing dimension. The unit particles can by agglomeration form needles and plates of larger dimensions.

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KC-385, Part 1

This document consists of 12 pages
No. 1 of 4 copies. Series A.

Date of Issue: December 10, 1956

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PART E
SAFETY AND PROTECTION
FROM
K-25 QUARTERLY REPORT
FOR FIRST FISCAL QUARTER
JULY 1, 1956 - SEPTEMBER 30, 1956 (U)

Classification Changed to CONFIDENTIAL
By Authority of PGD-4
Classification Authority
By R. B. Martin, Analysas Corp. 3-29-91
Date

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SAFETY AND PROTECTION

INTRODUCTION

This section treats the various aspects of the plant accident-prevention programs which have been established to prevent injury, personnel exposure to radiation, and damage to property. Also included in this section are descriptions of emergency planning activities for equipping the plant to cope effectively with emergency situations which may arise, and discussions of the security and plant protection activities designed to provide for protection of plant facilities and classified matter.

Potential hazards at the Oak Ridge Gaseous Diffusion Plant include not only those inherent in normal industrial and chemical plant operations, but also those due to the corrosive, toxic, radioactive, and fissionable properties of materials which are somewhat peculiar to this plant.

ACCIDENT AND INJURY EXPERIENCE

PERSONNEL

Injury Experience

The disabling injury frequency rate of 0.39 disabling injuries per million employee-hours worked was the lowest rate for any quarter in over 4 years and was the second lowest ever reported for the plant. In addition, the severity rate of 2 days lost or penalized per million employee-hours was the lowest such value recorded in the history of the plant.

One disabling injury-free period of 1,709,338 employee-hours, which began on June 9, 1956, was terminated on August 9, 1956, and another similar period of 1,428,819 employee-hours began on August 11, 1956, and is continuing.

Statistics on disabling injuries are shown graphically in figure E-1, and current injury rates are compared with those of other periods in table E-1.

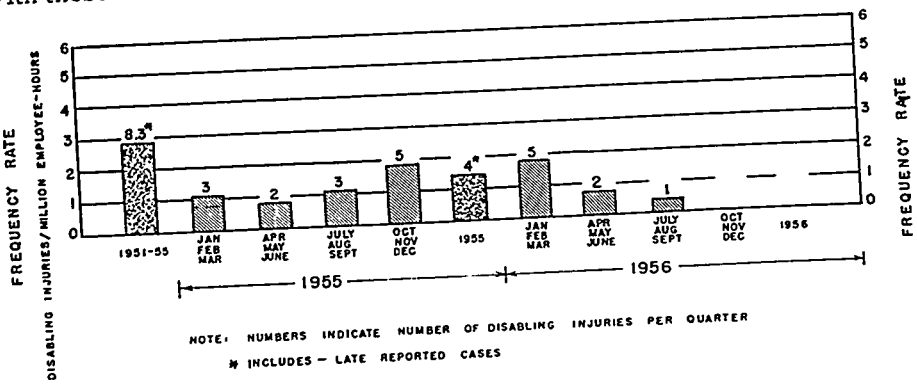

FIGURE E-1
Disabling Injury Frequency Rates

Personnel Monitoring

The plant acceptable limits for exposure to penetrating radiation were revised in accordance with the [redacted] CONFIDENTIAL

[redacted]

recommendations of the National Committee on Radiation Protection primarily in establishing a limit of 600 mrep per week for external beta radiation as compared with the previous limit of 300 mrep; the gamma limit of 300 mr per week remained unchanged. The combined beta and gamma radiation exposure are accordingly reported in terms of the "equivalent-gamma" exposure, with an exposure of 2 mrep beta being considered equivalent to 1 mr gamma.

There was 1 film badge exposure in excess of the plant acceptable limit, and the average film badge exposure was 2.1 mr equivalent gamma (3.8 mrep total beta and gamma), as compared to 2.8 mrep total beta and gamma for last period.

Film badge data are tabulated in table E-1 and are compared with the plant radiation index in figure E-2.

Personnel contamination limits were revised in accord with experimental results relating actual personnel exposure to the degree of such personnel contamination.

TABLE E-1
Accident and Injury Experience

		This Quarter	Last Quarter	1956[a]	1955[a]	1951 - 1955[a]
Injury Experience						
Frequency Rate[b] (Disabling Injuries)		0.39	0.76	1.64	1.46	2.91
Severity Rate[c]		2	45	93	1,137	602
Frequency Rate[b] (All Injuries)		321	345	334	314	333
Disabling Injuries		1	2	4.3	4	8.3
Medical Treatment Cases		832	902	879	860	937
Total Injuries		833	904	883	864	945
Accident Experience						
Property Damage						
Fires	No.	6	17	10	4.5	3.1
	Damage	$41	$700	$284	$136	$552
Motor Vehicle	No.	10	9	8.7	13	11
	Damage	$830	$300	$537	$748	$779
Equipment	No.	5	5	7	4	3.9
	Damage	$3,710	$197	$2,996	$4,040	$5,076
Total	No.	21	31	26	21	18
	Damage	$4,581	$1,197	$3,817	$4,923	$6,407
Material Releases						
Toxic or Corrosive		9	4	5	3.75	2.3
Radioactive		3	13	7.0	6.50	6.8
Other		0	1	0.33	0	0.05
Personnel Monitoring						-
Radiation Exposure						
Av. No. Film Badges/Wk.		571	566	572	551	511
No. Film Badges > P.A.L.[d]		1	6	5.7	2.3	10
Av. Equivalent γ Badge Exposure		2.1 (3.8)[e]	2.8[e]	2.6[e]	2.5[e]	11[e]
Maximum Exposure > P.A.L.[d]		0.40 (0.70)[e]	1.0[e]	1.0[e]	7.8[e]	33[e]
Routine Hand Checks						
Av. No. of Daily Hand Checks		498	550	527	533	554
Hand Checks > P.A.L.[d]		2	0	2.7	4.8	7.8
Personnel On-the-Job Spot Checks[f]						
Total Checks Made		201	273	282	380	893
No. > P.A.L.[d]		52	67	79	86	226
% Checks > P.A.L.[d]		26	25	28	23	25

a Where totals are concerned, these figures are quarterly averages. Values for disabling injuries include late reported cases.
b The injury frequency rate is the number of injuries per million employee-hours worked.
c The severity rate is the number of days lost or penalized per million employee-hours worked.
d P.A.L. - plant acceptable limit.
e Total beta + gamma, mrep.
f These include checks of employee's hands and clothing.

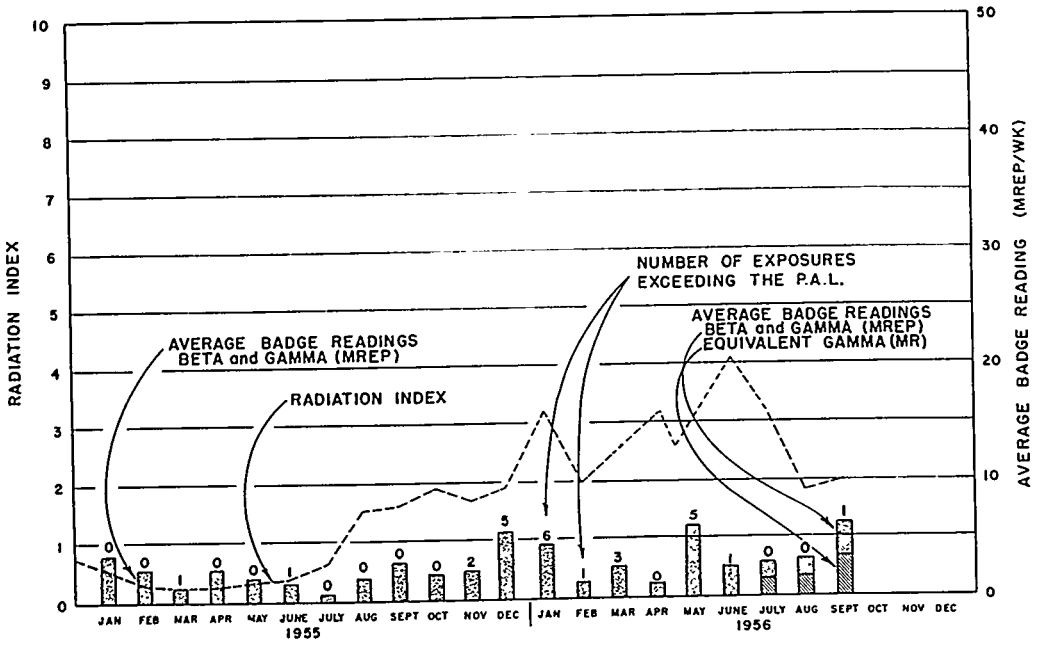

FIGURE E-2
Film Badge Exposure and Penetrating Radiation Index

PROPERTY DAMAGE

Property damage loses from all causes increased this period to $4,481 but remained well below comparable loss figures for 1955 and the 5-year base period; the increase is primarily attributable to motor damage amounting to $3,450 which resulted when lightning struck a 2400-volt overhead circuit, causing an over-voltage on pump-motor lines in the K-802 Cooling-Water Pump House.

There were considerable reductions in both the number of fires and the damage costs, the $41 damage being the lowest loss recorded this year and less than 30% of the average for 1955.

Although both the number of motor vehicle accidents and the associated damage costs increased over those for last period, with $830 damage for 10 accidents, the experience remained in line with the values reported for 1955 and for the preceding 5-year period.

OTHER INCIDENTS

Material Releases

Twelve material releases occurred, none of which indicated significant problems or unexpected hazards. Of the 9 releases involving corrosive materials, 6 were due to leaks in the aqueous hydrofluoric acid pipe line between the Feed Plant and the Tank Farm, and one to a rupture-disc failure in the dome of a railroad tank car containing aqueous hydrofluoric acid. In addition, there was a small release of sulfuric acid during maintenance on an acid line to a cooling tower, and in another incident, approximately 800 gallons of nitric acid was spilled in the plant as a result of a defective flange on the bottom of a transport truck from another plant, the acid damaging the truck beyond economical repair.

Of the 3 releases involving uranium materials, one resulted from a gasket rupture in Feed-Plant equipment, another was due to the failure of a rupture disc in a cylinder containing uranium

hexafluoride, and the third involved a contaminated oil spill from process equipment during maintenance operations.

Mechanical Equipment Failures

A review of plant hoisting equipment resulting in elimination of improper rigging was completed following an incident in which an improperly designed hoisting sling failed, dropping a crane load and causing a minor injury to an employee.

PROTECTIVE EQUIPMENT AND FACILITIES

PERSONNEL

Test results on 2 combination respirator canisters, to be used as protection against both particulate and gaseous materials, indicated that the canisters were unsatisfactory for plant use.

Checks of disposable-type paper-fiber coveralls and other garments showed them to be unsatisfactory for plant use.

PROPERTY

Permanent Fixtures

The scheduled removal of obsolete equipment and the establishment of standards governing the storage and disposal of excess and obsolete equipment and materials, as well as the improvement of storage facilities, have materially improved plant housekeeping conditions. Traffic safety was improved by the removal of temporary parking areas, installation of passenger loading zones, and the provision of additional traffic flow markings in congested plant areas.

Improved control of non-radioactive air-borne toxic or flammable materials was effected by modification of the exhaust systems in the K-1420 Decontamination Spray Booths, the installation of new exhaust systems for the test facility in the Barrier Development Laboratory, and the modification of exhaust systems over the ranges and deep-fat friers in the cafeteria.

As a result of reduced traffic on the plant railroads, a routine cleaning program was initiated to minimize the collection of rust on the rails which tends to interfere with the operation of the rail-crossing warning signals.

A number of deteriorated storage batteries that furnish emergency electric power to the fire alarm system were replaced, and 4 new auxiliary fire alarm boxes in the recently completed addition to the K-1004-L Pilot Plant were placed in service.

The semiannual inspection and flow tests of the 230 plant fire hydrants indicated that all were in usable condition, with only 17 minor faults being noted.

Although normal seasonal lightning caused interruptions to the fire alarm system on 12 occasions and produced some minor damage, the operating efficiency of this system, as well as the operating efficiencies of the sprinkler and fire-water systems, remained normal at better than 99.9%; these efficiencies are tabulated in table E-2.

Moveable Equipment

Additions to plant radiation detection equipment included 12 direct reading 0-200 mr dosimeters

and 12 direct reading 0-100 r dosimeters, 1 dosimeter charger, 5 beta-gamma survey instruments, and 2 alpha survey instruments. The results of audits of plant radiation instruments indicated that approximately 81% of the instruments checked were in satisfactory operating condition as compared to 75% last quarter.

TABLE E-2
Operating Efficiency of Fixed Fire Protection Systems

	This Quarter	Last Quarter	Year to Date[a]	1955[a]
Fire Alarm System				
Total No. alarm devices[b]	609	602	604	609
Alarm-hours outage[c]	301	989	666	5,895
Operating efficiency	99.98%	99.92%	99.95%	99.98%
Sprinkler Systems				
Total No. systems[b]	44	44	44	43
System-hours outage[c]	36	44	39	310
Operating efficiency	99.96%	99.96%	99.96%	99.89%
Fire Water System				
Total No. hydrants[b]	230	230	230	236
Hydrant-hours outage[c]	64	534	432	668
Operating efficiency	99.99%	99.89%	99.91%	99.97%

a Where totals are concerned, figures refer to quarterly averages.

b Number in service at end of periods noted.

c Outage given in unit hours. For example, a hydrant out of service for 1 hour is 1 hydrant-hour outage.

ACCIDENT PREVENTION ACTIVITIES

TEST ACTIVITIES

Acceptance Tests

Tests of the hydraulic back-pressure valve on the new Propane manifold in the K-1004-L Pilot Plant indicated that the equipment was satisfactory for the proposed operating conditions, and the equipment was accepted.

Qualification Tests

Only 1 subcontractor welder was tested. The issuance of driver permits and the results of driver and welder-testing for ORGDP personnel are tabulated in table E-3.

TABLE E-3
Qualification Tests

	This Quarter	Last Quarter	1956*	1955*	1953 - 1955*
Motor Vehicle Operators					
No. Permits Issued	113	90	96	94	132
No. Tests Given	6	10	8	13	71
No. Qualifying	5	10	7.3	12.8	68
% Qualifying	83	100	92	98	96
Welding Operators					
No. Tests Given	122	74	285	88	164
No. Qualifying	74	61	230	35	116
% Qualifying	61	82	81	63	71

* Where totals are concerned, figures refer to quarterly averages.

Cylinder Tests

All of the 93 government-owned compressed gas and process material cylinders which were retested in accord with established schedules met the retest requirements. The safety of chlorine-trifluoride cylinder handling and storage was significantly improved through disposal of 26 cylinders which had defective valves.

Special Tests and Test Specifications

Isotopic analyses of stream bottom mud to determine the uranium assay revealed no deposits of significantly enhanced uranium; radiochemical analyses of the potable water supply to determine concentrations of Sr^{89}, Sr^{90}, and Y^{90} indicated that the concentrations were below the limits of accurate detection and well below limits to produce a personnel hazard.

Field studies have been made to determine the employee heat stress produced by large scale maintenance activities in locations where ambient temperatures are significantly in excess of normal. Where necessary, increased ventilation and cooling have been provided on some of the jobs tested, and further studies are being made to determine if additional protective measures are necessary.

ENGINEERING DESIGN AND SPECIFICATIONS

New Construction and Alterations

Special Accident Prevention Considerations. A significant improvement in plant operations and facilities with respect to fire prevention was effected by the construction of mobile oxygen-acetylene manifold units to supply welding equipment used principally on process-improvement-program equipment changes, the use of these units reducing the congestion of welding hoses from large numbers of individual welding units.

The removal of anhydrous HF supply lines from an outside wall of the K-1131 Feed Plant to an underground concrete tunnel has considerably lessened the personnel exposure hazard of the area.

Additional bonding facilities were provided for an overhead crane in K-1420 to reduce ground resistance between the crane wheels and the track since it had been noted that the build-up of dirt and grease on the rail materially affected the ground resistance. Initial steps have been taken to shield and ground existing plant crane trolleys to bring them in line with the newly issued A.E.C. criteria.

Audit Results. Audit results of electrical installations associated with new facilities and major alterations to existing facilities indicate general compliance with design and specifications by outside contractors; approximately 93% of the items checked were satisfactory. Among the unsatisfactory items which were subsequently corrected to meet design specifications was the lack of system grounding on the secondaries of several new subcontractor-installed transformers. The results of the audits are summarized in table E-4.

TABLE E-4
Electrical Audits of New Facilities and Major Alterations

	This Quarter	Last Quarter	1956*	1954 - 1955*
No. of Items Checked	578	525	559	555
No. of Items Satisfactory	539	476	514	513
% of Items Satisfactory	93	91	92	92

* Where totals are concerned, the figures refer to quarterly averages.

Criticality Hazards

Six approval letters covering plant equipment and operations and a preliminary report on theoretical studies of the problem of neutron interaction between uranium containers were issued.

Criticality experiments at another UCNC installation have provided additional interaction data and information on low-moderation assemblies of UF_6 at 37.5% U-235 assay.

PROMOTION AND INFORMATIONAL ACTIVITIES

Suitable safety awards have been ordered for distribution to eligible employees in accord with the UCC Safety Award Plan in recognition of a period of 1,709,338 injury-free employee-hours completed.

Information concerning revised plant acceptable limits and contamination control methods was distributed to the plant in the form of Standard Reference Information and explained through a series of supervisory conferences. These plant limits and work practices were based upon the results of an extensive series of tests undertaken to evaluate the actual hazards associated with surface uranium contamination.

The safety interviews in the Carbide Courier were continued, and other normal media such as plant publications and signboards were utilized to present timely safety messages; the safety of work practices, the value of personnel protective devices, and vacation safety suggestions received special emphasis.

Although the number of safety meetings held throughout the plant increased slightly, this program of safety education has been expanded to 5,775 employee-contacts, an increase of approximately 80% over the number for the same period of 1955.

Table E-5 compares current safety meeting attendance with that of other periods.

TABLE E-5
Safety Meetings and Attendance

	This Quarter	Last Quarter	1956*	1955*	1953 - 1955*
Meetings Reported	339	323	348	179	217
Attendance	5,775	5,342	5,857	3,072	3,594

* Figures given are quarterly averages.

PLANT EVALUATION

Criticality Hazards

No deviations were noted in criticality audits of plant equipment and operations.

Mechanical

Of 945 safety and relief devices tested, repaired, or replaced, 53% were in good condition, 45% required cleaning, repair, or parts replacement, and 2% were inoperative. Of 55 rupture discs replaced, 35% were in good condition, the others having been blown, leaking, or otherwise damaged in operation. Of 528 pressure relief devices tested which had isolating stop valves, only 5 stop valves were found closed; however, 2 relief vent lines were found blanked, 1 having been on a feedwater heater and the other on an acid pump. The inlet and/or outlet of 170, or 72%, of all relief

valves tested in cooling water service, were found to be 25% or more obstructed with sediment or corrosion deposits and complete obstruction was found in 5 installations.

Ninety-five per cent of 465 pressure vessels inspected were considered safe for continued operation. Of 300 miscellaneous equipment items pressure tested, 88% were satisfactory and the remainder required repair to leakage points. No unusual conditions were noted during annual inspection and test of steam plant boilers 4 and 5 and in overspeed and safety device tests of 2 diesel engines.

Of 461 hoisting equipment inspections, 46% were in satisfactory condition; however, only 9.8% were considered sufficiently unsafe to require repair or replacement of the defective items prior to further usage of the equipment. The over-all condition of hoisting equipment showed a slight improvement over inspection findings of the past 2 quarters as may be seen in figure E-3.

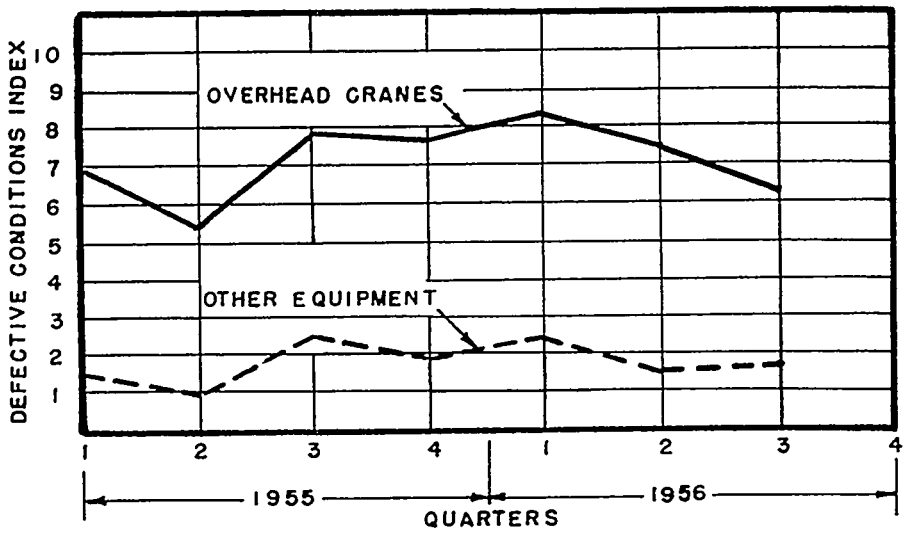

FIGURE E-3
Condition of Materials Handling Equipment

SAFETY, FIRE PROTECTION, AND ELECTRICAL

Audits of plant facilities indicated that conditions remained essentially unchanged with regard to routine safety, fire, and electrical hazards, about 90% of the items audited being considered satisfactory. The employee practices audited showed a slight improvement over last period with about 90% of those observed considered to be satisfactory. Current results of audits are compared with those of other periods in table E-6.

HEALTH PHYSICS

Alpha Contamination

Plant alpha contamination levels, as reflected by audit surveys of both operating and staff groups in the 58 locations where contamination is of particular concern, decreased 23% from that of last quarter. This decrease is primarily attributed to improvements in the powder-conveyor systems in the K-1131 Feed Production Area and the cleaning of contaminated surfaces in the K-1410 Decontamination facility. Contamination indices are tabulated in table E-7 and are shown graphically in figure E-4.

TABLE E-6
Safety, Fire Protection, and Electrical Audit Results

	This Quarter	Last Quarter	1956*	1955*
General Safety				
Plant Conditions				
Number Audited	14,980	14,719	14,904	8,696
Number Satisfactory	13,156	13,918	13,764	8,259
% Satisfactory	88	95	92	95
Employee Safe Practices				
Number Audited	1,544	1,600	1,670	1,653
Number Satisfactory	1,388	1,390	1,481	1,505
% Satisfactory	90	87	89	91
Fire Protection				
Number Audited	2,235	2,569	2,434	1,427
Number Satisfactory	2,107	2,382	2,267	1,345
% Satisfactory	94	93	93	94
Electrical				
Number Audited	8,316	8,574	8,461	4,045
Number Satisfactory	7,715	8,013	7,857	3,615
% Satisfactory	93	93	93	89

* Where totals are concerned, these figures refer to quarterly averages.

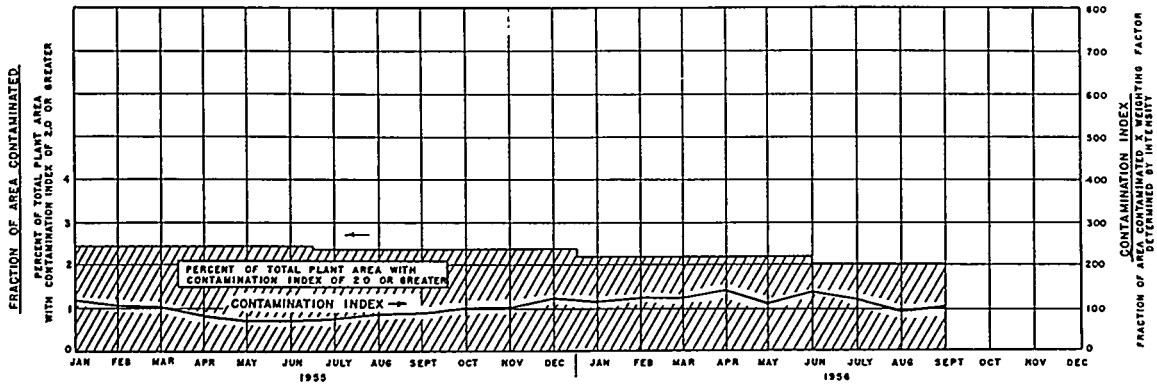

FIGURE E-4
Plant Contamination Levels

Penetrating Radiation Levels

The normal accumulation of beta-gamma emitting daughter products in equipment associated with the K-1131 Feed Plant continued to present the primary source of penetrating radiation; however, extensive clean-up and removal of obsolete and excess K-1131 process equipment have reduced the plant radiation index to 2.2 as compared to 3.3 for the last report period and 1.0 for 1955. A total of 79 routine beta-gamma monitoring reports was submitted by operating groups, this being the same as for last period.

Air Activity Levels

Decreases were noted in both the fraction of shift-length samples in excess of the plant acceptable limit and the average air activity indicated by this continual sampling program, primarily as a result of reduction in powder handling and maintenance on equipment in the K-1131 Feed Plant where a drop of about 60% in the average air activity was recorded. Similarly, the average spot-air activity

and the number of samples over-P.A.L. noted on routine surveys in areas where alpha air-borne activity is normally encountered decreased to the lowest average value recorded this year, due primarily to improved control of air-borne activity resulting from the seal-dismantling operation in the K-1420 Decontamination facility.

Air activity data are tabulated in table E-7 and are shown graphically in figure E-5.

TABLE E-7
Environmental Conditions

	This Quarter	Last Quarter	1956[a]	1955[a]	1953 - 1955[a]
Alpha Contamination					
Plant Contamination Index[b]	107	129	119	99	301
No. Locations Included	58	58	58	66	64
% Plant Area Surveyed[b]	2.0	2.2	2.1	2.0	2.0
Penetrating Radiation					
Radiation Index[c]	2.2	3.3	2.7	1.02	1.6
No. Locations Included	8	8	8	8	9
Air Activity (Shift-Length)					
No. Samples Taken	2,610	2,816	2,814	1,765	1,842
No. Above P.A.L.[d]	24	61	45	26	23
Av. Activity per Sample (c./min./ft.^{3})	0.09	0.17	0.12	0.17	0.15
Air Activity (Spot)					
No. Samples Taken	187	203	198	245	325
No. Above P.A.L.	9	11	15	14	35
Av. Activity per Sample (c./min./ft.^{3})	0.33	0.45	2.0	0.40	0.50[e]
Water and Sewage Control					
Av. Beta Activity of Plant Sanitary Water (dis./min./100 ml.)	15	18	25	28	34
U Concentration in Poplar Creek Mud (ppm.)	101	24	76	39	91
U Concentration in Clinch River Mud (ppm.)	0.93	1.1	1.4	3.2	2.5

a Where totals are concerned, figures refer to quarterly averages.
b Contamination Index is a figure which reflects the product of the extent and intensity of alpha contamination exceeding the P.A.L.; the values shown include only those plant locations with a 6-month average contamination index of 2.0 or greater.
c The Radiation Index, which reflects both the extent and intensity of radiation found, is essentially the product of the work area over which the dose rate is more than 7.5 mrep/hr. and a weighting factor which depends upon the actual radiation intensities over the area concerned.
d P.A.L. - Plant Acceptable Limit.
e 1954 and 1955 only.

Radium Source Checks

Two sources no longer required at the plant have been transferred to other AEC installations; routine checks of the remaining 20 plant radium sources revealed no evidence of source leakage.

Other Environmental Conditions

The average beta activity in the plant sanitary water decreased approximately 17% and continued to remain relatively low. Although the average activity of the mixed fission product waste material released from an upstream installation increased during this period, the increase was offset by the rise in the average flow of the Clinch River which resulted in above normal dilution of the waste materials.

The average uranium concentration in the mud from Poplar Creek, while increasing from 24 to about 100 ppm., remained well below significant levels of stream pollution, the increase being attributed to holdup of the normal release of material in the stream area as a result of decreased stream volume.

The average uranium concentration in the Clinch River remained very low and unchanged from the previous report period.

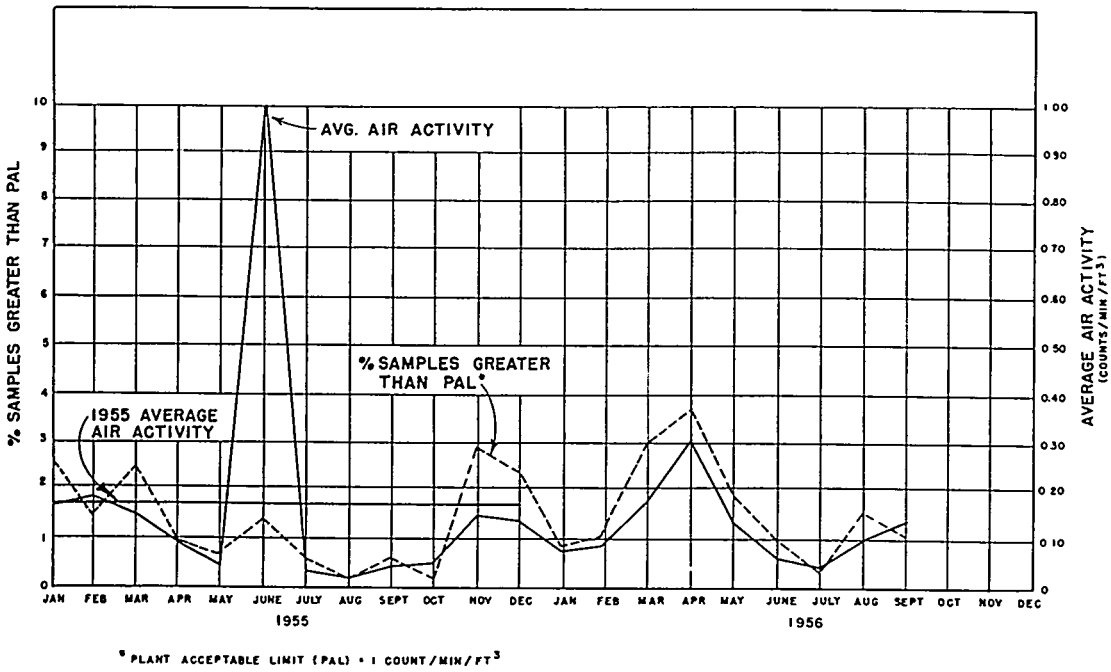

FIGURE E-5
Plant Air Activity on Shift-Length Air Samples

EMERGENCY ACTIVITIES

EVACUATION DRILLS AND EMERGENCY RESPONSES

Two simulated plant evacuation drills were held. One drill was primarily designed to test communications between emergency control stations and designated personnel dispersal points and to check "fall-out" plotting procedures, while the second drill simulated placing the plant in standby condition and evacuation to area parking lots. Other drills involved potential operational emergencies and were designed to train personnel to cope with conditions which might arise in their own locations and to determine the adequacy of possible "back-up" help from other locations. A total of 59 local and 7 plant-wide drills was staged, 51 involving multi-problem emergencies. In addition, the Fire Department trained 171 employees in the use of fire-fighting and respiratory protective equipment. Emergency equipment responses are tabulated in table E-8.

TABLE E-8
Emergency Equipment Responses

	This Quarter	Last Quarter	1956*	1954-1955*
Fire Fighting Equipment				
Alarms	47	40	39	44
Drills	51	49	46	38
Emergency Truck				
Alarms	31	23	26	36
Drills	49	48	41	34
Ambulance				
Illnesses	13	14	14	16
Drills	27	43	29	15

* Values given are quarterly averages.

SECURITY

SECURITY PRACTICES

Personnel Clearances

Security clearance was obtained for 113 prospective ORGDP employees and 63 clearance requests are pending. Similarly, 155 clearances were obtained for subcontractor and vendor personnel, with 64 requests pending.

Facility Clearances

One facility clearance was terminated.

PLANT SECURITY EVALUATION

Significant Items

A group of individuals viewing the plant from a parking lot outside the plant area but within the controlled area was apprehended while taking pictures and released to the AEC patrol.

Five instances of construction workers violating escort agreements and/or working area assignments were appropriately handled for corrective action. There was no indication that security was compromised.

Audits

Frequent audits of subcontractor work being performed inside the plant areas revealed only minor violations involving administrative security instructions.

A continuing audit on tube sheet shipments from Fairbanks-Morse and Company reveals an improvement in the method of preparation for shipment.

A reduced metal shipment which had been opened en route to relocate the load which had shifted was audited and found satisfactory.

The number of classified documents missing atthe end of the quarter totaled 174, representing an increase of 11 from the previous quarter.

A daily check of top secret repositories indicated 99.95% compliance with locking regulations.

Security Education

The second quarterly security educational bulletin titled "Safeguarding Classified Information" was distributed to each employee, through line organization.

Supervisory staff meetings, line supervision, and employee on-the-job instructions, together with close liaison of the security staff with line supervision continued to be utilized as educational mediums. Security reminders were carried in the Carbide Courier.

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KC-385, Part 2

Date of Issue: March 6, 1957

This document consists of 18 pages
No. 1 of 4 copies. Series A.

RHG 35,204
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PART E
SAFETY AND PROTECTION
FROM
K-25 QUARTERLY REPORT
FOR SECOND FISCAL QUARTER
OCTOBER 1, 1956 - DECEMBER 31, 1956 (U)

DISTRIBUTION

1-2. Director of Production, O. R. O., A. E. C.

3. Booth, Dr. E. T.

4. Lyon, Dr. J.

Classification Changed to CONFIDENTIAL
By Authority of PGD-4
Classification Authority
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SAFETY AND PROTECTION

INTRODUCTION

This section treats the various aspects of the plant accident-prevention programs which have been established to prevent injury, personnel exposure to radiation, and damage to property. Also included in this section are descriptions of emergency planning activities for equipping the plant to cope effectively with emergency situations which may arise, and discussions of the security and plant protection activities designed to provide for protection of plant facilities and classified matter.

Potential hazards at the Oak Ridge Gaseous Diffusion Plant include not only those inherent in normal industrial and chemical plant operations, but also those due to the corrosive, toxic, radioactive, and fissionable properties of materials which are somewhat peculiar to this plant.

ACCIDENT AND INJURY EXPERIENCE

PERSONNEL

Injury Experience

The major-injury frequency rate of 1.17 disabling injuries per million employee-hours worked compares favorably with the corresponding value of 1.72 for the year, this latter value being only slightly above the plant's best record of 1.42 which was established last year. The annual severity rate of 80 days lost or penalized per million employee-hours worked was the lowest such value recorded in the history of the plant.

PART E

Associated with this favorable experience was an extended period of 3,423,557 employee-hours without a disabling injury; this period, the longest in the history of the plant, began on August 11, and extended for 120 days through December 8, 1956. It represents the second injury-free period in excess of 1,000,000 employee-hours experienced during 1956, the previous one of 1,709,338 employee-hours having been attained from June 9 through August 9.

Statistics on disabling injuries are shown graphically in figure E-1 and current injury rates are compared with those of other periods in table E-1.

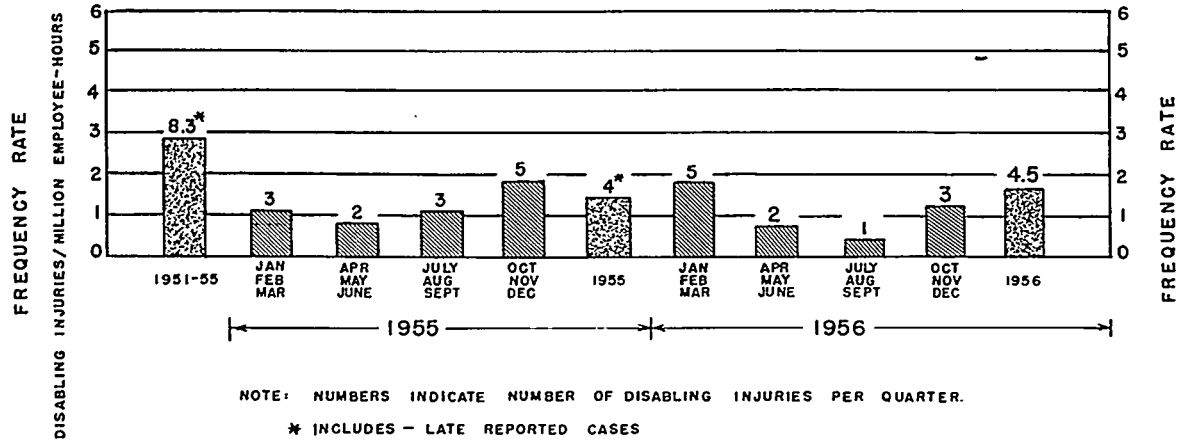

FIGURE E-1
Disabling Injury Frequency Rates

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TABLE E-1
Accident and Injury Experience

		This Quarter	Last Quarter	1956[a]	1955[a]	1951-1955[a]
Injury Experience						
Frequency Rate[b] (Disabling Injuries)		1.17	0.39	1.72	1.46	2.91
Severity Rate[c]		19	2	80	1,137	602
Frequency Rate[b] (All Injuries)		287	321	323	314	333
Disabling Injuries		3	1	4.5	4	8.3
Medical Treatment Cases		734	832	841	860	937
Total Injuries		737	833	846	864	945
Accident Experience						
Property Damage						
Fires	No.	12	6	11	4.5	3.1
	Damage	$10	$41	$215	$136	$552
Motor Vehicle	No.	15	10	10	13	11
	Damage	$1,850	$830	$865	$748	$779
Equipment	No.	9	5	7.5	4	3.9
	Damage	$991	$3,710	$2,495	$4,040	$5,076
Total	No.	36	21	29	21	18
	Damage	$2,851	$4,581	$3,575	$4,923	$6,407
Material Releases						
Toxic or Corrosive		2	9	4.3	3.75	2.3
Radioactive		1	3	5.8	6.5	6.8
Other		1	0	0.5	0	0.05
Personnel Monitoring						
Radiation Exposure						
Av. No. Film Badges/Use Period		566	571	571	551	511
No. Film Badges > P.A.L.[d]		0	1	4.3	2.3	10
Av. Equivalent γ Badge Exposure (mrep)		1.7(3.1)[e]	2.1(3.8)[e]	1.8(3.1)[e]	2.5[e]	11[e]
Maximum Exposure > P.A.L.[d] (rep)		None	0.40(0.70)[e]	0.50(1.0)[e]	7.8[e]	33[e]
Routine Hand Checks						
Av. No. Daily Hand Checks		467	498	512	533	554
Hand Checks > P.A.L.[d]		0	2	2	4.8	7.8
Personnel On-The-Job Spot Checks[f]						
Total Checks Made		308	201	289	380	893
No. > P.A.L.[d]		23	52	65	86	226
% Checks > P.A.L.[d]		7.5	26	23	23	25

a Where totals are concerned, these figures are quarterly averages. Values for disabling injuries include late reported cases.
b The injury frequency rate is the number of injuries per million employee-hours worked.
c The severity rate is the number of days lost or penalized per million employee-hours worked.
d P.A.L. - Plant Acceptable Limit.
e Total beta + gamma.
f These include checks of employee's hands and clothing.

Causes of Injury

Unsafe acts of employees were the major factors in about 85% of the injuries experienced during the year, and is similar to the value reported for 1955. Figure E-2 shows the contribution to the total injury experience of various types of unsafe acts and conditions.

Personnel Monitoring

Despite recent increases in the penetrating radiation levels of the plant there were no personnel exposures exceeding the P.A.L. this period. However, the 17 over-P.A.L. exposures reported for the year represent an increase over the 9 experienced in 1955, this being attributed to the increased radiation fields associated with the accumulation of uranium daughter products in the K-1131 Feed Production facility. From figure E-3, where film badge data are compared with the radiation index, it is seen that this general upward trend in radiation has been evident since June, 1955, when feed production was resumed following an extensive equipment improvement program in the feed plant.

The issuance of film badges was changed from a weekly to a biweekly schedule to permit the detection of lower average exposures than was previously possible; operating economies also resulted from this move.

The average weekly badge exposure of 1.8 mr equivalent gamma and 3.1 mrep beta plus gamma, as reported for the year, represents little change from the similar values reported for 1955. Film badge data are tabulated in table E-1.

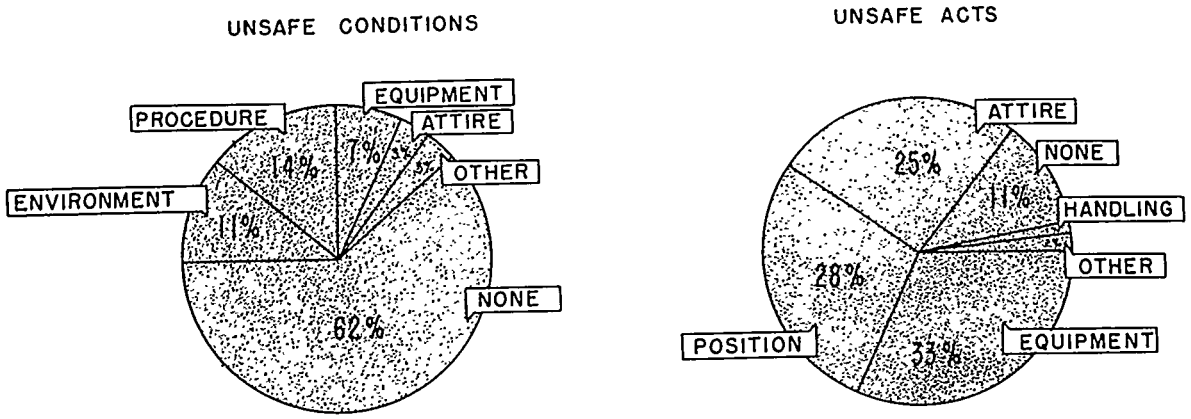


FIGURE E-2
Injury Causes

Personnel contamination indicated by spot checks of personnel on the job decreased considerably, but the yearly average remained essentially unchanged from that of 1955; comparative values are shown in figure E-4 and table E-1. Routine hand monitoring reports for 1956 indicate a decrease from 1955 of about 50% in the number of over-P.A.L. checks recorded, the decrease being attributed to improved supervisory control procedures.

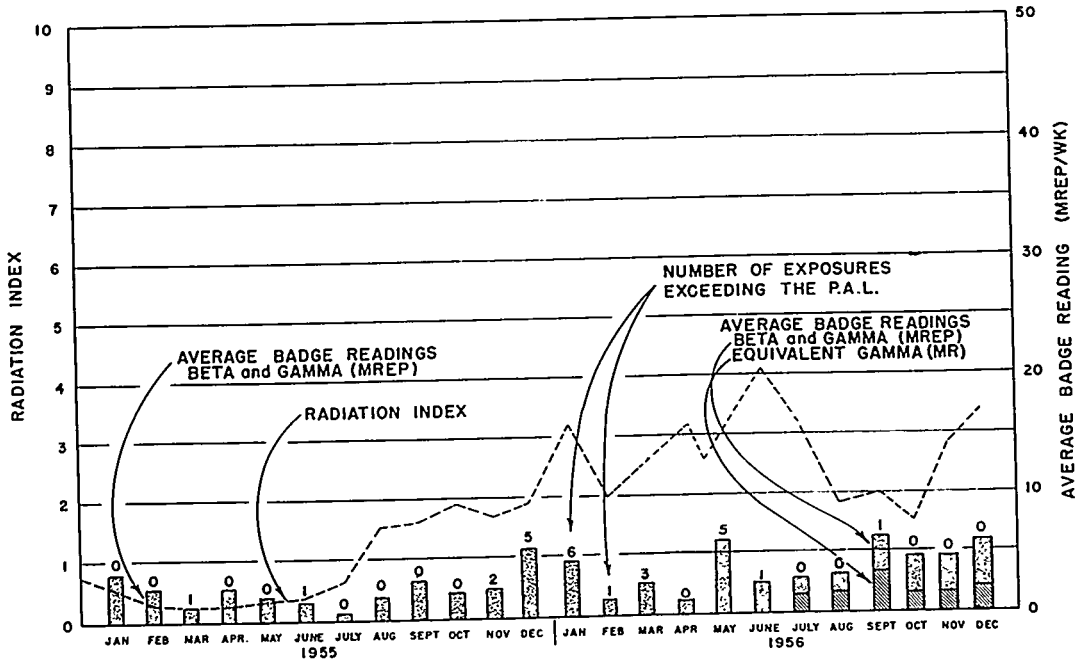


FIGURE E-3
Film Badge Exposure and Penetrating Radiation Index

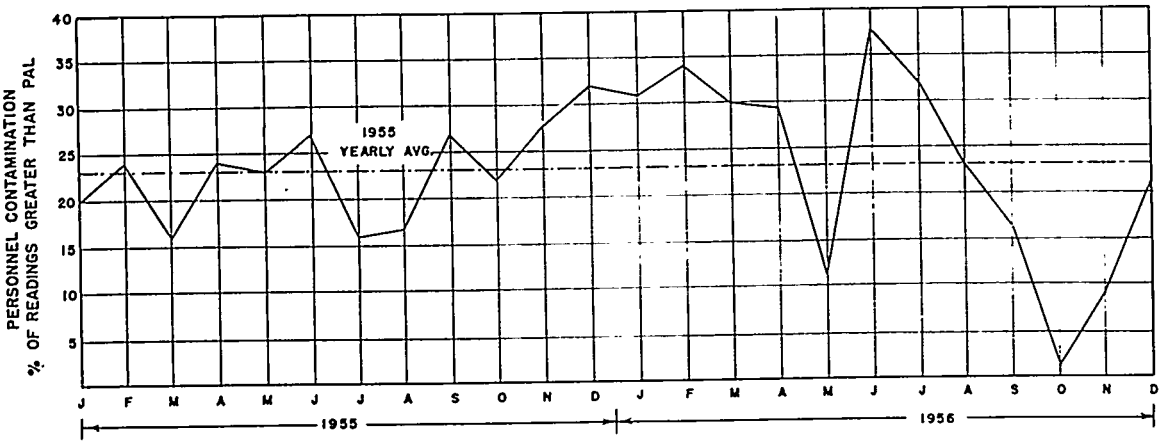


FIGURE E-4
Hand, Shoe, and Clothing On-The-Job Contamination

PROPERTY DAMAGE

The total property damage loss of $2,851 represented a 36% reduction over last period, and the average loss of only $3,600 per quarter for 1956 was the lowest such value reported since 1951.

Current accident experience is compared to that of other periods in table E-1 and figures E-5 and E-6.

OTHER INCIDENTS

Material Releases

None of the 4 material releases indicated significant problems or unexpected hazards, and the yearly total of 42 such incidents represents no significant change from the 1955 experience.

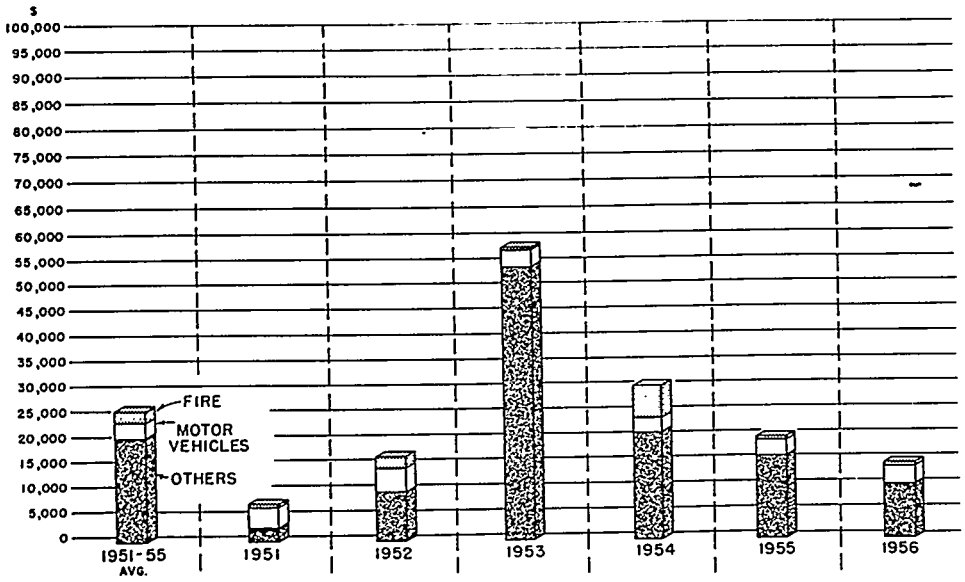


FIGURE E-5
Accident Loss

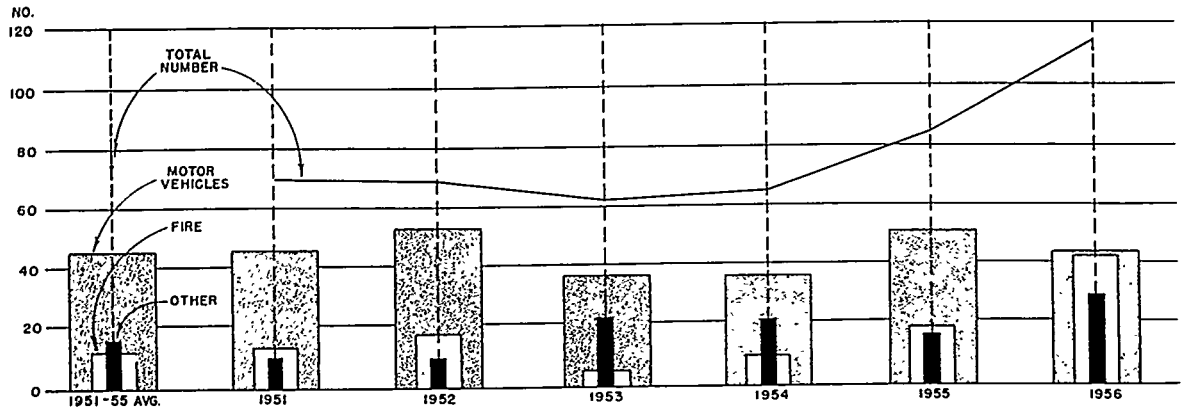


FIGURE E-6
Number of Property Damage Accidents

PROTECTIVE EQUIPMENT AND FACILITIES

PERSONNEL

Field tests of specially designed "air-conditioned" jackets and helmets, which employ dry ice in a finned heat exchanger to create a flow of cooled air throughout the garments, revealed that under moderate heat-exposure conditions these units provide health protection and confort equivalent to that provided by the air-supplied suits developed at ORGDP and permit greater freedom of movement; however, at temperatures in excess of about 140° F. and for periods of 30 minutes or more the air-supplied suits are superior.

PROPERTY

Permanent Fixtures

Improved control of radioactive air-borne materials was effected by the installation of 2 hoods in the K-1420 Small Parts Dismantling Room where activity greater than the plant acceptable level had frequently been noted on routine air sampling.

Improvements on the fire-alarm system included slight revisions to the alarm switches of the 63 deluge valves of the water-spray systems in the electric switchyards to eliminate a long-standing difficulty with these switches; and a minor modification of the supervisory control devices of the smoke detection system in the K-724 Records Storage Vault to eliminate trouble alarms.

The current plant complement of fire alarm boxes is 552, and there are 50 other alarm devices actuated by the 41 sprinkler and 63 spray systems. The fire-water system of the plant includes 2 fire-water tanks with a total capacity of 400,000 gallons, approximately 83,200 feet of fire mains, 230 fire hydrants, 3 electric pumps, and 1 Diesel-powered fire pump.

The operating efficiencies of the fixed fire-protection systems shown in table E-2 continued to be normal at over 99.9%.

Moveable Equipment

Additions to plant radiation equipment this year included 4 beta-gamma survey instruments, 11 alpha survey instruments, 8 Hi-Vol Air Samplers, one 4-fold hand counter, twelve 0-100 r direct

reading dosimeters, twelve 0-200 mr direct reading dosimeters, and one dosimeter charger. Table E-3 summarizes the number of radiation detection instruments available in the plant. The results of audits of these radiation detection instruments show that about 81% of those checked were in satisfactory operating condition this year as compared to 75% in 1955.

About 60 additional portable fire extinguishers were installed, bringing the total number of such extinguishers in the plant to approximately 6830.

TABLE E-2
Operating Efficiencies of Fixed Fire Protection Systems

Fire Alarm System	This Quarter	Last Quarter	Year to Date[a]	1955[a]
Total No. alarm devices[b]	609	609	605	609
Alarm-hours outage[c]	288	301	572	1,474
Operating efficiency	99.98%	99.98%	99.96%	99.89%
Sprinkler Systems				
Total No. systems[b]	44	44	44	43
System-hours outage[c]	57	36	43	78
Operating efficiency	99.94%	99.96%	99.96%	99.89%
Fire Water System				
Total No. hydrants[b]	230	230	230	236
Hydrant-hours outage[c]	344	64	410	167
Operating efficiency	99.93%	99.99%	99.92%	99.97%

a Where totals are concerned, figures refer to quarterly averages.
b Number in service at end of periods noted.
c Outage given in unit hours. For example, a hydrant out of service for 1 hour is 1 hydrant-hour outage.

TABLE E-3
Radiation Detection Instruments

Constant Air Monitors	2
Air Samplers	50
Minometers	16
Dosimeters	44
Dosimeter Chargers	4
Beta-Gamma Survey Meters	200
Alpha Survey Meters	225
Hand Counters	27

ACCIDENT PREVENTION ACTIVITIES

TEST ACTIVITIES

Acceptance Tests

Tests of a recently installed manually-controlled CO_2-fire-extinguisher system in the exhaust system for the K-1002 Cafeteria gave satisfactory results.

Qualification Tests

There was a noted increase in the number of qualification tests given to subcontractor welders for work on lump-sum construction projects, and an increase in motor-vehicle operator testing was associated with the qualification of personnel to operate a new special purpose truck of larger capacity than has previously been used. The number of motor-vehicle-operator permits issued and the results of qualification tests for welders and motor-vehicle operators are tabulated in table E-4.

TABLE E-4
Qualification Tests

	This Quarter	Last Quarter	1956*	1955*	1953-1956*
Motor Vehicle Operators					
No. Permits Issued	69	113	89	94	132
No. Tests Given	33	6	14.3	13	71
No. Qualifying	33	5	13.8	12.8	68
% Qualifying	100	83	97	98	96
Welding Operators					
ORGDP Welders					
Number of Tests Given	141	122	111	88	151
Number Qualifying	93	74	81	35	107
% Qualifying	66	61	73	63	71
Subcontractor Welders					
Number of Tests Given	17	2	4.75	12	428
Number Qualifying	7	2	2.25	8	302
% Qualifying	41	100	47	66	70.5

* Where totals are concerned, figures refer to quarterly averages.

ENGINEERING DESIGN AND SPECIFICATIONS

Standards

The cylinder-valve standards of the Compressed Gas Association for nitrogen, helium, and argon cylinders were adopted to eliminate the possibility of interchanging hydrogen cylinders with helium cylinders and argon cylinders with oxygen cylinders. All other types of cylinders at the plant conform to CGA standards or alternate standards and constitute no interchangeability problem.

New Construction and Alterations

Special Accident Prevention Considerations. Preliminary design and cost estimates for the shielding or guarding of most of the existing open crane trolleys to comply with recently issued AEC criteria for new installations of this type, and design and specifications for sprinkler systems for the protection of the lithium-hydroxide and barrier-tube storage areas in the process buildings were completed.

Improvements effected with respect to the handling of flammable gases included the installation of double valving in the K-1131 Feed Plant hydrogen lines to reduce the possibility of an inadvertent accumulation of hydrogen in a valved-off system, and the relocation of existing oxygen and acetylene manifolds from inside the K-1420 Decontamination Building to an outside location.

A thorough review of plant hazards and control measures, especially as they concern the fire safety of cascade facilities, has been initiated to re-evaluate the adequacy of the protective measures provided, as they concern equipment and operational procedures. Among the specific actions taken have been the changing of operational instructions to see that process building roof areas are as well vented as possible in the event of a fire, additional restrictions on the movement of vehicles in process areas, and increased emphasis in the emergency drill program on the problems of combatting potential lubricating oil fires.

Cathodic protection was provided for an underground [redacted] line at the K-1100 Barrier Plant to prevent recurrence of a leak which produced a severe fire exposure hazard to nearby facilities.

Improved storage conditions have been effected both through the use of polyethylene linings in drums containing acidic solutions to prevent corrosion and leakage, and through the institution of

venting procedures to preclude hazardous pressure build-up in stored drums.

Audit Results. Audits of electrical installations associated with new facilities and major alterations to existing facilities indicate general compliance with specifications and code requirements by outside contractors; approximately 93% of all items checked this year were satisfactory as compared to 91% for last year. Most of the items requiring correction this year involved lack of circuit identification. Audit results are summarized in table E-5.

TABLE E-5
Electrical Audits of New Facilities and Major Alterations

	This Quarter	Last Quarter	1956*	1955*
No. of Items Checked	377	578	514	575
No. of Items Satisfactory	361	539	478	523
% of Items Satisfactory	96	93	93	91

* Where totals are concerned, the figures refer to quarterly averages.

Nuclear Safety

The revision of two summary approval letters covering plant equipment and operations to include new data was completed, and two technical reports on interaction and one significant non-critical incident report were issued. Documents issued during the year included 32 approval letters, one significant non-critical incident report, and 4 technical reports.

Criticality experiments involving highly enriched uranium systems of interacting containers were continued at another UCNC installation, and the experimental data, together with their theoretical interpretation, were used to develop new safe interaction criteria which are somewhat less restrictive than current ORGDP specifications for container spacing.

Items of major significance during the year included the establishment of plant criteria for safe tee, ell, and cross pipe connections on the basis of experimental data, and the experimental determination, for the first time, of the critical mass for an unmoderated, unreflected assembly of enriched uranium, using 37.5% U-235 assay blocks of UF_4-$(CF_2)_n$.

PROMOTION AND INFORMATIONAL ACTIVITIES

Safety awards were distributed to eligible employees in accord with the UCC Award Plan in recognition of a period of 1,709,338 injury-free employee-hours completed in August. Suitable awards have been selected for a period of 3,423,557 employee-hours completed during the current quarter, which represents a new ORGDP record.

Employee interest in accident prevention, which was stimulated by the achievement of new employee-hour goals, was further promoted through articles published in the plant paper, safety award displays at various plant locations, the installation of a "telephone-answering service" carrying a progress report and daily safety message, and various supplements to plant billboards.

Off-the-job promotional material included the distribution of a pamphlet, prior to the holiday season, "Choosing Safe Toys for Safe Play". Other normal media such as plant publications and bulletin boards were utilized to present pertinent safety messages, and the 1957 Safety Calendar incorporating safety bulletin insert space was distributed for plant use.

Although the number of safety meetings held throughout the plant showed little change over last period, the number of meetings held and the attendance at such meetings were significantly higher than comparable values for 1955 and the 3-year base period.

Table E-6 compares current safety meeting attendance with that of other periods.

TABLE E-6
Safety Meetings and Attendance

	This Quarter	Last Quarter	1956*	1955*	1953-1956*
Meetings Reported	336	339	345	179	249
Attendance	6,421	5,775	5,998	3,072	4,195

* Figures given are quarterly averages.

NUCLEAR SAFETY

No deviations from the provisions of approval letters were noted by audit inspections. As a result of improved operating methods and closer supervision of processing operations, only 5 deviations from the provisions of approval letters were noted this year as compared to 11 for 1955, and none were noted this quarter. The single significant non-critical incident which occurred resulted from the somewhat improbable, simultaneous double contingency of misoperation and failure of a heating system.

MECHANICAL

The operational safety of boilers, pressure vessels, relief devices, cylinders, hoisting apparatus, turbines, and diesel engines was found comparable to that of previous quarters. Door interlocks of two hydraulic elevators were found to have been wedged open, and misoperation of the oil bypass valve was evident on one hydraulic elevator. A ball and socket superheater tube joint of No. 5 Steam Plant boiler was found to be leaking under test. Although all of 11 emergency diesel generator units operated safely under test, starting or operating difficulties were experienced on 3 units.

Results of tests and inspections of mechanical equipment are summarized in table E-7, and the condition of materials-handling equipment is shown graphically in figure E-7.

TABLE E-7
Mechanical Inspections and Tests

	This Quarter	Last Quarter	1956*
Pressure Relief Devices			
No. Tested, Repaired, or Replaced	931	1000	975
No. Satisfactory	402	520	544
% Satisfactory	43	52	56
% With Obstructed Vents[a]	15	17	12
% With Stop Valves Closed[b]	1.5	0.9	1.8
Compressed Gas and UF_6 Cylinders			
No. Tested	392	118	382
No. Satisfactory[c]	382	118	376
% Satisfactory	97	100	98
Boilers and Pressure Vessels			
No. Inspected or Tested	1126	765	919
No. Satisfactory[c]	944	703	830
% Satisfactory	84	92	90
Hoisting Equipment[d]			
No. Inspected or Tested	367	461	445
No. Satisfactory	333	415	401
% Satisfactory	91	90	90

* Quarterly averages listed.
a Includes vents with 25% or more obstruction on inlet or outlet.
b Installations on which shut-off valves are installed.
c Includes equipment with minor defects not affecting safe operation.
d Includes cranes, hoists, elevators, lifts, and winches.

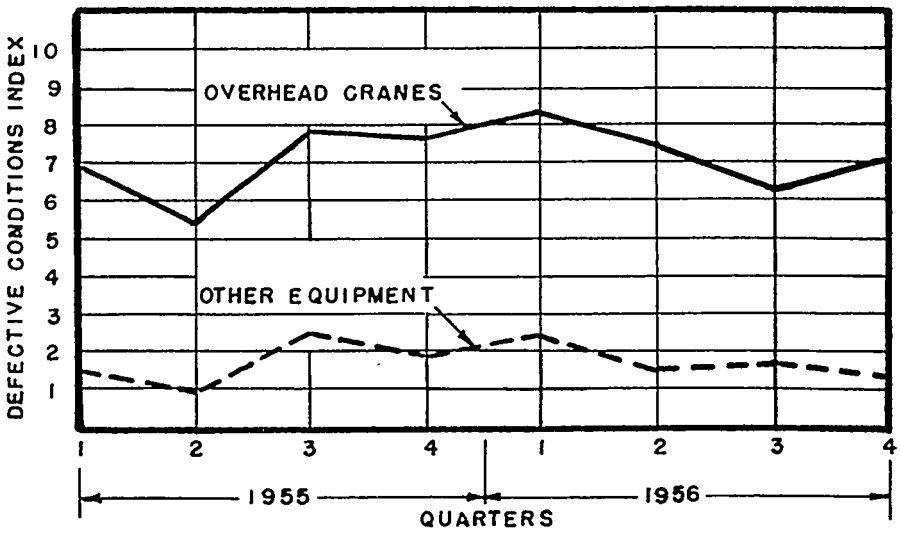


FIGURE E-7
Condition of Materials-Handling Equipment

SAFETY, FIRE PROTECTION, AND ELECTRICAL

Audits of plant facilities and employee practices with regard to normal operating hazards indicated a slight improvement in plant conditions this period with 94% of the items audited being considered satisfactory. Employee violations of safe practices as determined from field audits remained unchanged with about 10% of the observed practices being considered unsatisfactory.

Current results of audits are compared with those of other periods in table E-8.

TABLE E-8
Safety, Fire Protection, and Electrical Audit Results

	This Quarter	Last Quarter	1956*	1955*
General Safety				
Plant Conditions				
Number Audited	12,968	14,980	14,430	8,696
Number Satisfactory	12,199	13,156	13,383	8,259
% Satisfactory	94	88	93	95
Employee Safe Practices				
Number Audited	1,433	1,544	1,613	1,653
Number Satisfactory	1,249	1,388	1,424	1,505
% Satisfactory	87	90	88	91
Fire Protection				
Number Audited	2,073	2,235	2,345	1,427
Number Satisfactory	1,992	2,107	2,199	1,345
% Satisfactory	96	94	94	94
Electrical				
Number Audited	7,654	8,316	8,263	4,045
Number Satisfactory	7,165	7,715	7,687	3,615
% Satisfactory	94	93	93	89

* Where totals are concerned, these figures refer to quarterly averages.

HEALTH PHYSICS

Alpha Contamination

Plant alpha contamination levels, as reflected by audit surveys of both operating and staff groups in the 58 plant locations where significant contamination is encountered, decreased [illegible] second consecutive quarter. The contamination control aspects of the feed-production and equipment-decontamination facilities continued to be adequate, and, although feed production and equipment maintenance and decontamination operations were normal, the contamination index for 1956 was only slightly higher than that of 1955, when feed production was suspended for approximately 6 months for equipment improvement and when contamination was at the lowest levels reported in over 5 years. The results of the current audits are summarized and compared in table E-9, and are shown graphically in figure E-8.

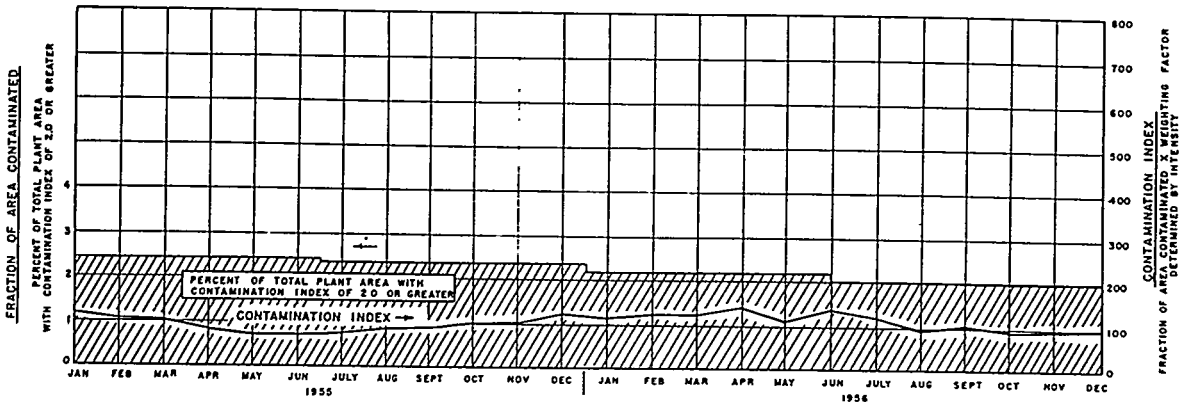


FIGURE E-8
Plant Contamination Levels

Penetrating Radiation Levels

The normal accumulation of beta-gamma emitting daughter products in equipment associated with the K-1131 Feed Plant continued to present the primary source of penetrating radiation. An increased quantity of K-1131 process equipment being stored prior to decontamination influenced the slight increase in radiation index from 2.2 last period to 2.6 for this period and maintained the index for the year at almost double that of 1955 when feed production was curtailed due to renovation of the processing facility.

The 73 routine beta-gamma monitoring reports submitted by operating groups represent little change from last period, but a significant increase was noted for the year with 331 surveys received as compared to 86 for 1955.

Air Activity Levels

Both the fraction of shift-length samples in excess of the plant acceptable limit and the average air activity indicated by this continual sampling program remained essentially unchanged, with the resulting activity level for the year decreasing about one-third from those recorded in 1955 and in the 3-year base period. This favorable experience primarily resulted from improved methods of powder handling in the K-1131 Feed Plant during the second half of the year.

Both the average spot-air activity and the number of samples over-P.A.L. noted on routine surveys in areas where alpha air-borne activity is normally encountered increased markedly due primarily to air-borne contamination noted during the non-routine dumping of incinerator ash in a process

storage area where the use of respiratory protective devices is mandatory. In addition, the annual levels were also influenced by the peak air-borne contamination noted in the powder pulverizing operations during the first quarter.

Air activity data are tabulated in table E-9 and are shown graphically in figure E-9.

Radium Source Checks

Routine checks of the 20 plant radium sources revealed no evidence of source leakage.

Other Environmental Conditions

The average beta activity in the plant sanitary water supply increased by a factor of 2 over the previous period; however, there was no significant change from the average activity of the same period last year. The increase may be attributed primarily to the decrease in the flow of the Clinch River following water hold-up in the Norris Reservoir as is normal for this period of the year; thus the dilution of the mixed-fission-product waste materials released to the river from an installation upstream from the ORGDP was significantly reduced. The average activity for the year of 26 dis./min./100 ml is slightly lower than the 1955 average and indicates no apparent health hazard.

The average uranium concentration in the mud of Poplar Creek increased as a result of uranium build-up in silt deposits following routine disposal of contaminated solutions from plant decontamination and recovery locations and from adjacent streams draining from another installation. There was relatively no change in the concentrations found in the Clinch River for the period or for the year, and concentrations in Poplar Creek remain well below the maximum permissible levels recommended by national authorities.

Table E-9 compares present water and mud activities with those of other periods, and the beta activity in the sanitary water supply is shown in figure E-10.

TABLE E-9
Environmental Conditions

	This Quarter	Last Quarter	1956[a]	1955[a]	1953-1955[a]
Alpha Contamination					
Plant Contamination Index[b]	95	107	116	99	301
No. Locations Included	58	58	58	66	64
% Plant Area Surveyed[b]	2.0	2.0	2.1	2.0	2.0
Penetrating Radiation					
Radiation Index[c]	2.6	2.2	2.7	1.02	1.6
No. Locations Included	8	8	8	8	9
Air Activity (Shift-Length)					
No. Samples Taken	2,689	2,610	2,783	1,765	1,842
No. Above P.A.L.[d]	33	24	42	26	23
Av. Activity per Sample (c./min./ft.3)	0.08	0.09	0.11	0.17	0.15
Air Activity (Spot)					
No. Samples Taken	192	187	197	245	325
No. Above P.A.L.	14	9	15	14	35
Av. Activity per Sample (c./min./ft.^{3})	2.0	0.33	2.0	0.40	0.50[e]
Water and Sewage Control					
Av. Beta Activity of Plant Sanitary Water (dis./min./100 ml)	33	15	26	28	34
U Concentration in Poplar Creek Mud (ppm.)	138	101	91	39	91
U Concentration in Clinch River Mud (ppm.)	3.0	0.93	2.0	3.2	2.5

a Where totals are concerned, figures refer to quarterly averages.
b The contamination index is a figure which reflects the product of the extent and intensity of alpha contamination exceeding the P.A.L.; the values shown include only those plant locations with a 6-month average contamination index of 2.0 or greater.
c The radiation index, which reflects both the extent and intensity of radiation found, is essentially the product of the work area over which the dose rate is more than 7.5 mrep/hr. and a weighting factor which depends upon the actual radiation intensities over the area concerned.
d P.A.L. - Plant Acceptable Limit.
e 1954 and 1955 only.

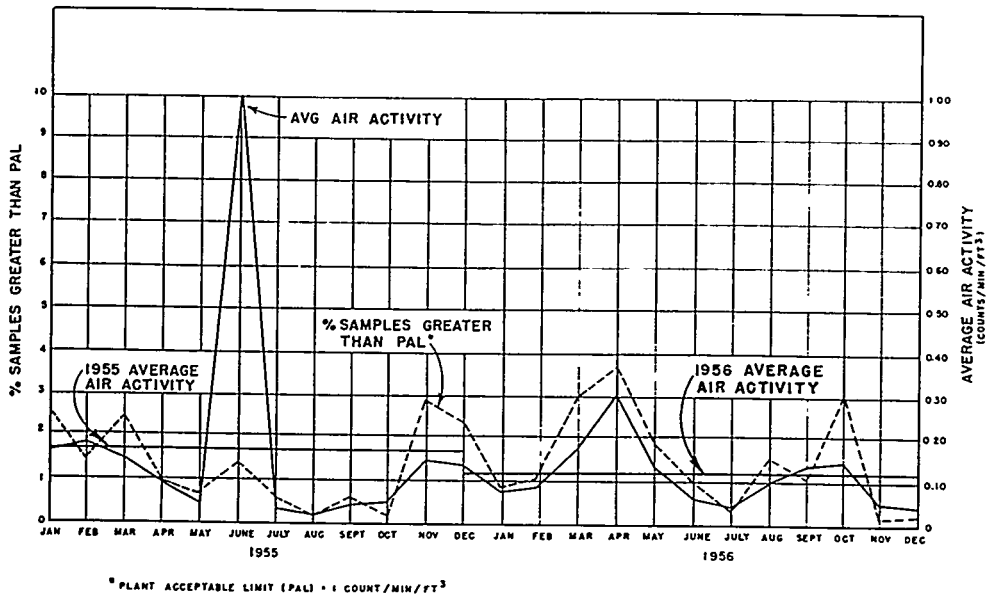


FIGURE E-9
Plant Air Activity on
Shift-Length Air Samples

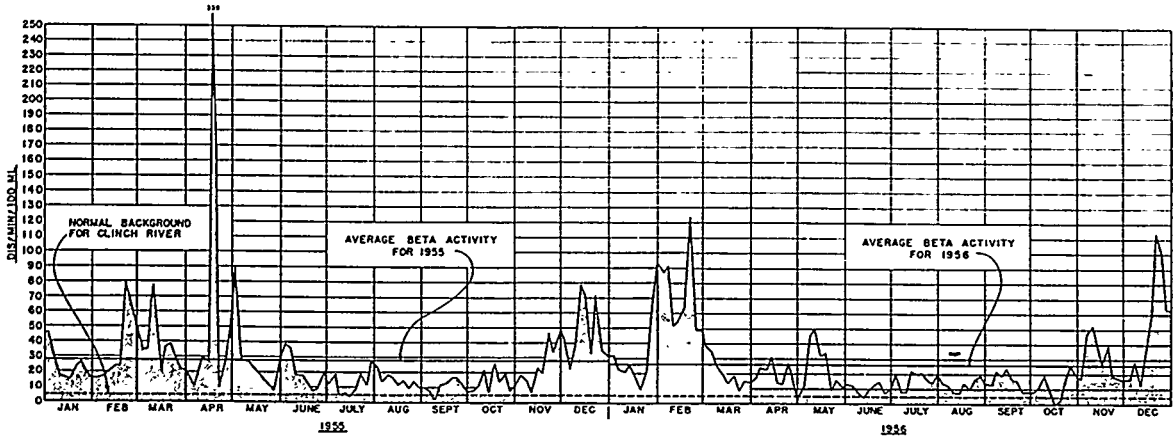


FIGURE E-10
Beta Activity in
ORGDP Sanitary Water

CONFIDENTIAL

Significant Plant Locations of Hazardous Materials

Figure E-11 shows the principal locations of some of the more hazardous materials at ORGDP and also indicates the average extent and intensity of radioactive surface contamination in the plant.

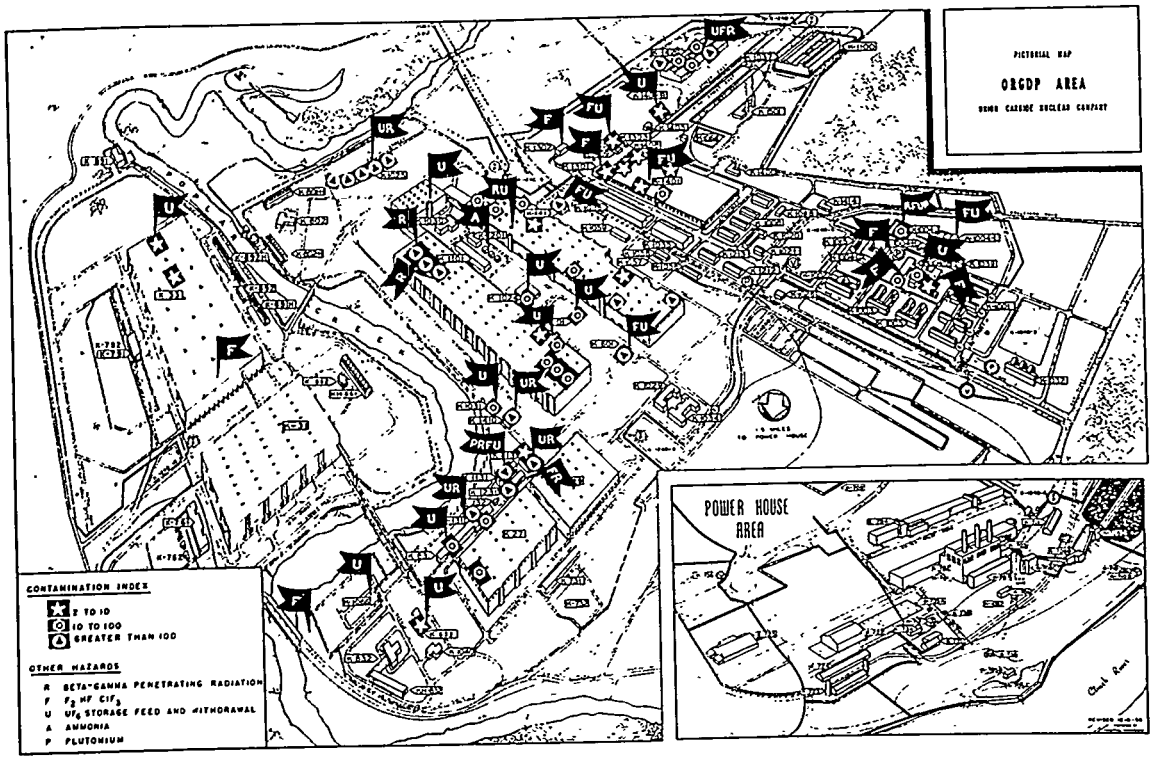


FIGURE E-11
Locations of Radioactive Contamination and Hazardous Materials

EMERGENCY ACTIVITIES

EVACUATION DRILLS AND EMERGENCY RESPONSES

The training of local emergency squads continued to receive emphasis in the emergency training program; 56 local emergency drills and 6 drills involving plant-wide problems were simulated. As in the past, the emergency drills are planned to acquaint employees with potential operational emergencies and to provide training which will enable them to cope successfully with conditions which might arise during such emergencies. During the year, 232 simulated emergency drills were staged, as shown in table E-10, and the ORGDP also participated in the Civil Defense air-raid test alert and in operation UNCAP in cooperation with the Oak Ridge Operations Office. One hundred and ninety four employees received training in the use of fire-fighting and respiratory protective equipment.

Emergency equipment responses are tabulated in table E-11.

TABLE E-10
Emergency Drills Conducted in 1956

Fires and Explosions	110
Material Releases	62
First-Aid	37
Operational Failures	14
Other	9
Total	232

TABLE E-11
Emergency Equipment Responses

	This Quarter	Last Quarter	1956*	1954-1955*
Fire Fighting Equipment				
Alarms	36	47	38	44
Drills	46	51	46	38
Emergency Truck				
Alarms	22	31	25	36
Drills	43	49	42	34
Ambulance				
Alarms	6	13	12	16
Drills	19	27	27	15

* Values given are quarterly averages.

SECURITY PRACTICES

Personnel Clearances

Security clearance was obtained for 84 prospective ORGDP employees and 27 clearance requests are pending. Similarly, 113 clearances were obtained for subcontractor and vendor personnel, with 53 requests pending.

Facility Clearances

One facility clearance was terminated.

PLANT SECURITY EVALUATIONS

Significant Items

Although there were 4 violations of uncleared visitor regulations as noted below, there were no indications that security was compromised in any of them.

1. An unauthorized visit to a sensitive area was made by an uncleared person escorted by a Q-cleared AEC employee.

2. A truck driver was allowed to proceed to an exit portal without escort after unloading his truck.

3. Two subcontractor employees were found working out of sight of their escort.

4. An uncleared visitor was escorted to a sensitive area without prior arrangements through the Security Department.

Identification credentials providing access to the plant, including the Barrier Plant, were established July 16, 1956, for a contractor employee at the request of the Commission. These credentials were rescinded November 13, 1956, when it was discovered that his Q-clearance had been cancelled on May 9, 1956; however, it is not known whether the man entered the plant during the time his clearance was inactive. Subsequently, the AEC reinstated the Q-clearance, effective June 29, 1956.

Audits

Audits of subcontractor work being performed inside the plant area revealed only minor violations involving administrative security instructions which were subsequently corrected.

An audit was made of seal parts prepared for shipment to vendors 'The method appeared adequate and no violations of security were observed.

Representatives of the Security Department were present during surveys made by representatives of the Commission on the premises of General Chemical Division, Allied Chemical and Dye Corporation, Baton Rouge, Louisiana, and Fairbanks-Morse and Company, Beloit, Wisconsin.

A continuing audit of tube sheet shipments from Fairbanks-Morse and Company has revealed that these shipments are arriving in excellent condition, security-wise.

Of the more than 225,000 classified documents in plant accountability, the number now missing is 187, this representing an increase of 13 from the previous quarter.

A daily check of top secret repositories indicated 99.96% compliance with locking regulations.

SECURITY EDUCATION

The third quarterly security educational bulletin, titled "Safeguarding Classified Material", was distributed to each employee through line organization.

Posters depicting the theme "Make Sure That Visitors are Properly Escorted" were displayed on all plant bulletin boards.

Supervisory staff meetings, line supervision, and employee on-the-job instructions, together with close liaison of the security staff with line supervision, continue to be utilized as educational mediums. Security reminders were carried in the Carbide Courier.

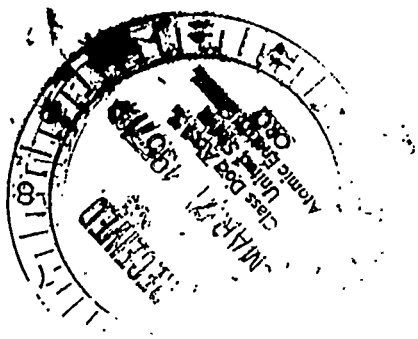
ALIEN REPORT

With the approval of the AEC, and in accordance with the agreement for cooperation with the United Kingdom, two British aliens were admitted to the plant for an unclassified tour, and two aliens from Belgium were also admitted for unclassified tours.

REPORTS

1. Henry, H. F., Knight, J. R., and Newlon, C. E., *General Application of a Theory of Neutron Interaction*, 11-15-56, (K-1309).

2. Henry, H. F., Newlon, C. E., and Knight, J. R., *Self-Consistent Criteria for Evaluation of Neutron Interaction*, 12-21-56, (K-1317).



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" PROCESS GAS LOSSES IN A GAS CENTRIFUGE " (U)

Extract of K-1620

S. W. Palmer, Author. *

Declassified/Unclassified
MALCOLM THEISEN, EASI
Name (ADC) - Organization
JUN 07 1996
Date

SUMMARY

Substantial progress has been made in reducing process gas losses in a gas centrifuge. Loss rates of from 0.06 mg UF_6/min to 0.12 mg UF_6/min have been demonstrated at cascade conditions with 6-inch-diameter subcritical centrifuges. These loss rates, a factor of 5 to 10 less than those of the present cascade machine, significantly enhance the potential of the gas centrifuge, especially for uranium or plutonium isotopic purifications. For example, for enriching normal uranium to 90% U-235, an ideal plant of these new machines need be only 1.06 times larger than a no-loss ideal plant. This factor for the early cascade centrifuges exceeded 1.50. Experiments showed that consumption is the major loss mechanism for the current machines. The design discipline that resulted in lowest gas loss rate was careful choice of materials, low temperatures, and inventory confinement within and above the rotor. Several experiments indicate that if, in addition, reactive vapors are confined below the molecular pump, further reductions in the loss rate will be achieved.

DISCUSSION

Losses With Current Machines

Gas loss rates of from 0.06 mg UF_6/min to 0.12 mg UF_6/min have been demonstrated at cascade conditions with 6-inch-diameter subcritical centrifuges. These rates are low enough that centrifugation can be considered for uranium or plutonium isotope separations (1,2). The significance of this achievement is seen by recalling that these loss rates are 5 to 10 less than those of our present cascade machines which, in turn, have loss rates of less than one hundredth that of the original Zippe machine.

To date, the machine with the lowest gas loss rate [redacted] machine currently under test at the Savannah River Laboratory. The loss rate on this machine is 0.06 mg UF_6/min at conditions that are definitely suitable for a cascade (2). With PuF_6, the loss rate was not significantly greater than with UF_6. This loss was achieved at [redacted] although even at [redacted] the loss rate is only slightly greater. Another low loss machine (UC-88) also operated at [redacted] and achieved a loss rate of 0.12 mg UF_6/min. This machine, however, did not reach this low loss level until it had been in service 112 days; whereas, [redacted] machine achieved a low loss performance in less than a week. [redacted] is therefore of more practical interest. This machine is basically the [redacted] cascade machine shown in figure 1. Table I summarizes the differences [redacted] and a standard cascade machine.

As noted, the changes were designed to decrease the amount of UF_6 that effuses through the annular opening at the top of the rotor, to confine

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* [redacted] are centrifuge assemblies designed and built at ORGDP to have the low gas loss characteristics required for potential future applications.

Declassification Authorized with deletions
RADIELL MARCHANT, UCN CLASSIFICATION OFFICER
NAME (ADD) - ORGANIZATION
6/7/96
DATE
Extract from K-1620

P.P. 11, 15, 16, 17, 18, 19, 27, 29, 34 extract

REBn

any UF_6 that does exit, to present materials of low consumption to the process gas, and to decrease the temperature level.

The effect of various operating conditions on the loss rate[ ] are shown in figures 2, 3, and 4, taken from the Savannah River Laboratory report (2) on this machine. From these data, M. D. Boersma (2) concludes that the limiting loss mechanism for this machine is reaction with contaminants originating[

The effects of operating time, rotor speed, and top scoop line pressure are shown for the other machines as figure 5. The data shown are typical; the trends and magnitudes have been found on many machines. All the data are consistent with the idea that increasing the inventory, by increasing the top scoop line pressure or by decreasing the speed, increases the gas pressure at the axis; this permits more gas to exit the rotor and hence the gas loss increases. The gas loss rate is independent of feed rate except for the fact that, to permit cascading machines, the top scoop line pressure must exceed the feed header pressure. The latter pressure is, of course, a function of the feed rate so that the minimum gas losses at cascadeable conditions do depend on the feed rate.

The loss[ ]and UC-88 are not consistent in one important manner. [

UC-88 did not behave this way.

TABLE II

GAS LOSS FOR UC-88 AS FUNCTION OF PUMPING MODE

Top Scoop Line Pressure =

Top Casing Valve	Bottom Casing Valve	Loss Rate, mg UF_6/min
Closed	Open	0.12
Open	Open	0.20
Closed	Closed (open ca 10% of time)	0.08

Centrifuge
Bowl Speed
Coolant Temperature

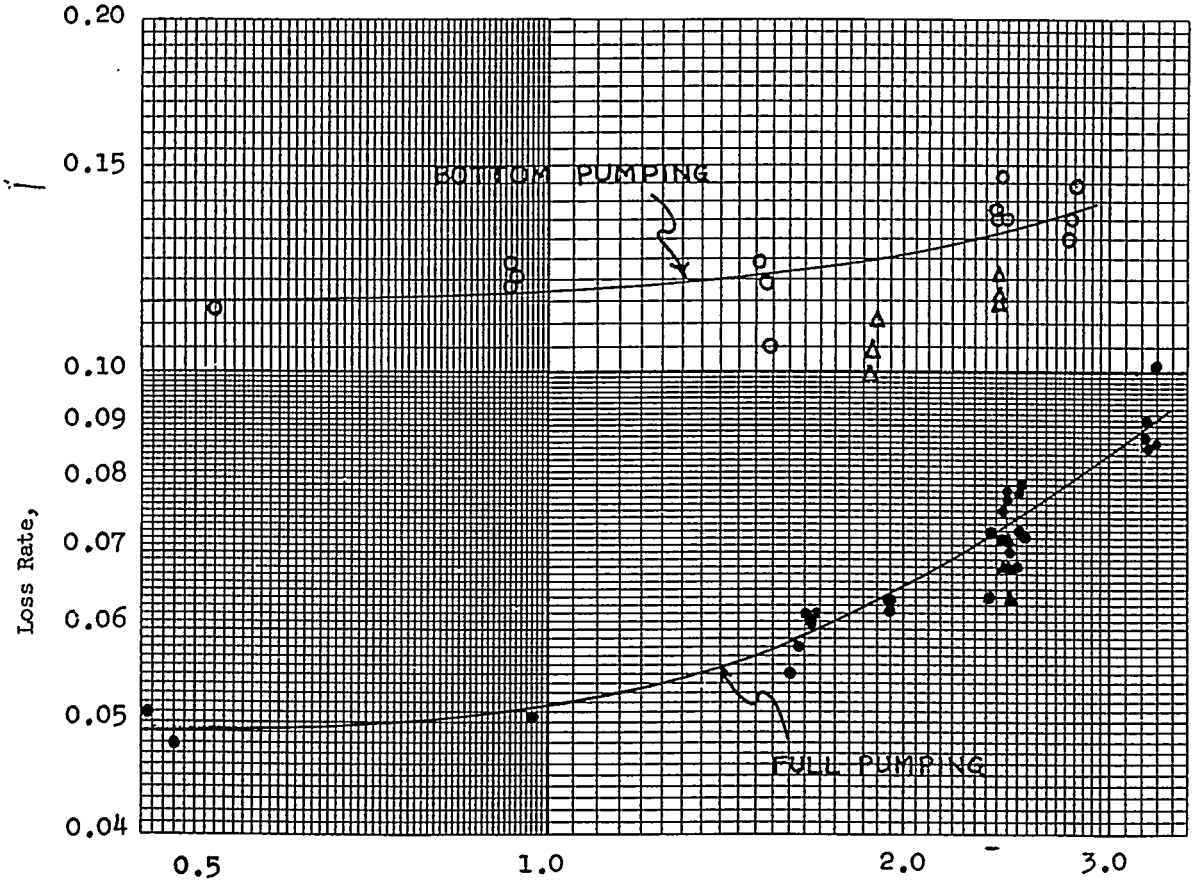


Figure 3
LOSS RATE OF CENTRIFUGE AT

]Centrifuge
Bowl Speed |
Coolant Temperature

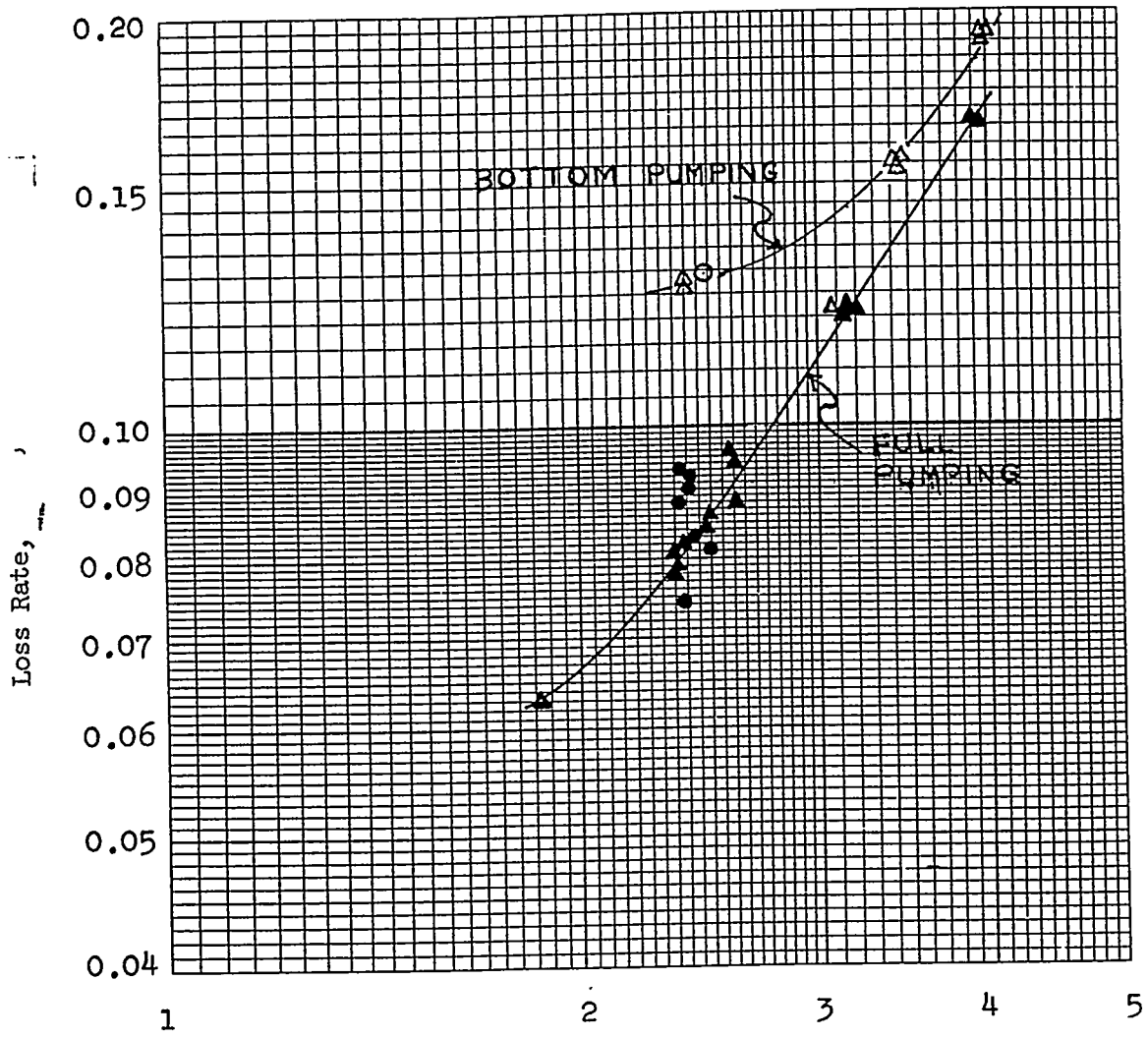
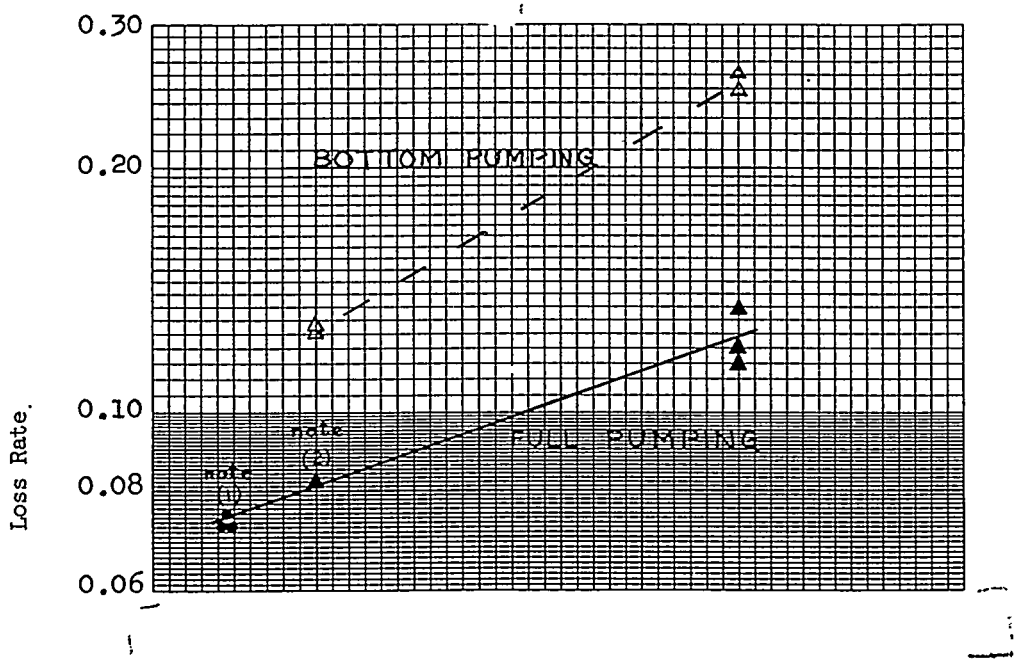


Figure 2
LOSS RATE IN CENTRIFUGE AT

Centrifuge
Bowl Speed
Top Scoop Line Pressure



Temperature of Coolant "out", °C	Other Measured Temperatures, °C			
	Coolant "in"	Center	Top Scoop	Bottom Scoop

Notes: 1. Loss rates measured at and adjusted to using curves on Figures 1 and 2.

2. Value for loss rate taken from curve, Figure 1.

Figure 4
LOSS RATE CENTRIFUGE AT VARIOUS TEMPERATURES

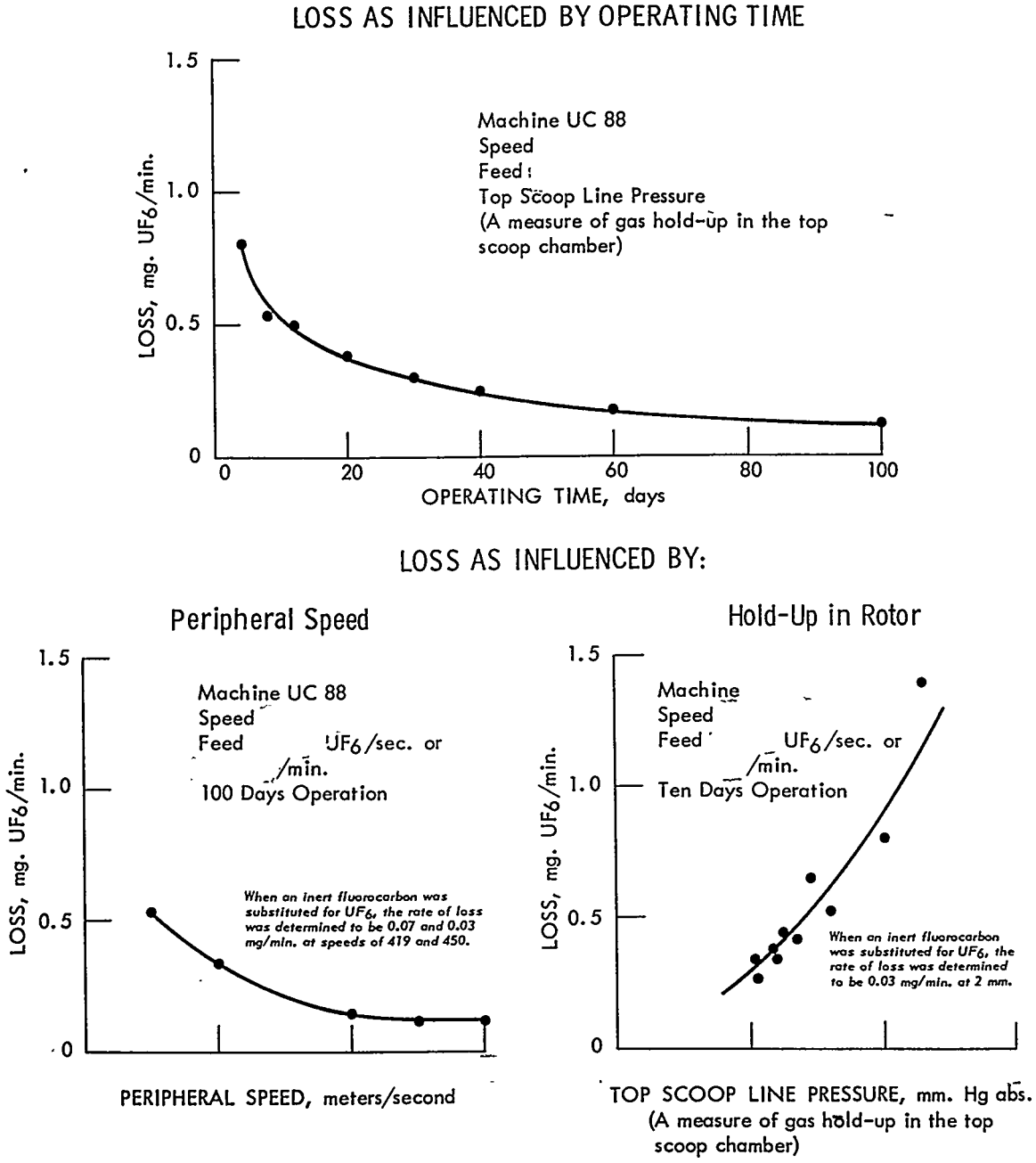


Figure 5

PROCESS GAS LOSS FROM A GAS CENTRIFUGE

In the subcritical centrifuges currently being developed, an annular clearance rather than a seal is provided between the stationary scoop lines and the rotating end cap. The magnitude of gas transport through this annular opening is dependent on many factors. The influence of three of these, peripheral speed, consumption of the process gas by materials of construction, and the quantity of gas held-up in the rotor, is shown in the graphs above.

columnar arrangement of centrifuges so that selection of operating conditions is of prime importance.

Effects of Gas Losses in a Centrifuge System

The importance of minimizing the loss of process gas in an isotope separation facility was clearly spelled out in the early work on isotope separation. The phenomenon of gas losses in a centrifuge is not new. However, greater emphasis on the reduction of these losses has been prompted by recent advances in centrifuge technology which have shown the feasibility of the process for some isotope separations.

The demand that a gas centrifuge permit very small gas loss comes about for a number of reasons:

1. The number of centrifuges required to do a specified separation job increases as the rate of gas loss increases.

2. Material recovery or decontamination costs increase with increasing gas loss.

3. If the process gas is radioactive, additional shielding and monitoring costs are introduced as the losses increase.

4. The operating life of a centrifuge is possibly a function of the gas loss rate, especially when the process gas is reactive.

5. The question of criticality is introduced or, at least, complicated by the existence of process gas loss.

As this listing implies, the economics involved are clearly a function of the specific separation task under consideration. For some cases, e.g., a small isotopic alteration using a cheap, inert gas, a high gas loss rate, say 1% of the feed rate, might be tolerated. Such cases, however, appear to be academic. The cases of interest today involve reasonably large isotopic alterations, using a process gas that is relatively expensive and usually radioactive. Here, a loss rate of 1% is prohibitive. Two situations involving large isotopic changes have received attention. The first requires a large production rate so that ideal cascade calculations are considered and the second requires a small production rate so that column arrangement of centrifuges are proposed. The influence of gas loss for both these cases has been evaluated. These calculations serve to set reasonable goals for the development effort.

The enriching section of the ideal cascade with losses have been treated by R. P. Feynman (4), H. Lefkowitz and B. Schwartz (5), and G. R. Theurich (6). Slightly different assumptions are used by each but the conclusion is the same, namely, that for this case, the increase in the size of each stage is a function of the ratio of process gas lost to the separative work performed. (This correlating parameter is essentially proportional to y/ϵ^2 where y is the fraction of the feed which is lost and $\epsilon = \alpha - 1$, α being the separation factor from feed to product). The increase in

TABLE III

INFLUENCE OF PROCESS GAS LOSS ON SIZE OF IDEAL ENRICHING PLANT

System: U-235/U-238

CASE 1: Feed: Normal Assay, 0.714 mol% U-235
Product: 90.0 mol% U-235

Loss Function: Gas Lost Per Machine, kg U/yr / Separative Work Per Machine, kg U/yr	Size Increase: Total Flow in Plant with Losses / Total Flow in no-Loss Plant
0	1.00
0.02	1.09
.04	1.19
.06	1.30
.08	1.42
.10	1.55
.12	1.69

These values were calculated for elements with a separation factor (product to feed) of 1.10. Smaller increases in plant size are calculated for separation elements having much smaller separation factors, e.g., for $\alpha = 1.01$ and a loss function of 0.12, the size increase is 1.60.

CASE 2: Feed: Normal Assay, 0.714 mol% U-235
Product: 20.0 mol% U-235

Loss Function: Gas Lost Per Machine, kg U/yr / Separative Work Per Machine, kg U/yr	Size Increase: Total Flow in Plant with Losses / Total Flow in no-Loss Plant
0	1.00
0.02	1.03
0.04	1.05
0.06	1.07
0.08	1.09
0.10	1.11
0.12	1.14

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Recommended Limits for Discarding Contaminated Wastes at K-25

RHTG # 60,489
BOX # 798 # 267

Purpose:

It is the purpose of this report to establish concentration limits, based on stated assumptions, for discarding contaminated solutions and contaminated carbon.

PART I: CONTAMINATED SOLUTIONS

1. Procedure:

The cost of handling and recovery of contaminated solutions will be equated to the value of the contained "T" at the corresponding X-assay. The concentration of "T" in the solution at which the solution handling and recovery cost is equal to or less than the value of the contained "T" is computed.

2. Production Costs:

A curve relating the cost of "T" to enrichment has been prepared by the Theoretical Analysis Department. This curve was obtained by evaluating "T" at any concentration by finding the loss or gain at present product concentration when "T" is removed or added to the cascade.

3. Recovery Costs:

Cost of recovery figures are taken from a report to Mr. L. L. Anthony, Jr., by Mr. J. H. Julien, October 30, 1946. These are:

DECLASSIFICATION RECOMMENDED
MALCOLM THEISEN, EASI
Name (ADC) - Organization
MAY 21 1996
Date

TABLE I

Class	A	B	C	D	E
Recovery Cost of Contaminated Solution, dollars per gallon	4.05	3.23	1.64	1.39	1.26
Upper Limit, wt. % X	3320301 1.03	2293304 5.33	1332509 14.25	6939104 29.91	2797000 59.70

3 WRS

4. Solution Discard Limits:

Figure No. 1 shows at which concentrations the value of "T" recovered from contaminated solutions equals the cost of recovery. Below these concentrations, the cost of recovery exceeds the value of the material recovered.

Page 1 missing
DECLASSIFICATION AUTHORIZED
GABRIEL MARCIANTE, ORO CLASSIFICATION OFFICER
NAME (ADD) - ORGANIZATION
5/28/96
DATE

REBn

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The given limits are based on the previously given production and recovery costs.

5. Estimated Volume of Discard:

TABLE II

Class	Class Median X-Assay Wt. %	Solution Inventory Pounds of "T"	"T"-Value Dollars/ Pounds	Total Value Dollars	Solution Inventory Gallons	Recovery Cost Dollars/ Gallons	Total Recovery Cost Dollars
A	1127502 .75	460	15	6,900	9,270	4.05	37,600
B	2251802 3.18	115	440	50,600	10,380	3.23	33,500
C	3427903 9.79	12	1725	20,700	3,670	1.64	6,000
D	4650803 22.68	25	4090	102,500	4,900	1.39	6,800
E	1598005 44.80	5	9110	45,500	760	1.26	950

The above class inventories, both in pounds of "T" and gallons of solution, are based on an approximate October 1, 1946 inventory.

The value of the "T" in the classes is estimated by the median X-assay of the class upper and lower limit X-assay.

It is estimated that nearly all of Class A and about 50% of the Class B contaminated solutions consist of filtrates and washings of "T" concentrations below the minimum concentrations given in Table II for these classes and may therefore be discarded as uneconomical to recover.

The following table indicates the portion of the contaminated solutions formed by Class A and 50% of Class B:

TABLE III

	Gallons	No. of Containers	Pounds "T"	Ave. Wt. % X
Class A and 50% Class B	14,400	350	516	3329702 .97
All Classes	28,000	700	616	4455903 2.59

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PART II: CONTAMINATED CARBON

1. Procedure:

The cost of handling and recovery of contaminated carbon will be equated to the value of the contained "T" at the corresponding X-assay. The concentration of "T" in the contaminated carbon at which the cost of handling and recovery is equal to or less than the value of the contained "T" is computed.

2. Production Costs:

The same production costs assumed in "Part I, Contaminated Solutions" are used.

3. Recovery Costs:

Costs of recovery figures are taken from a report to Mr. F. H. Anderson by Mr. J. H. Julien.

These are:

TABLE IV

Class	A	B
Recovery Cost of Contaminated Carbon, dollars per pound	4.83	2.44
Upper limit, Wt. % X	3320301 1.03	2293304 5.33

Information on recovery costs for classes C, D, and E are not available at this date.

4. Carbon Mixtures Discard Limits:

The following table shows at which concentrations the value of "T" recovered from contaminated carbon equals the cost of recovery. Below these concentrations, the cost of recovery exceeds the value of the material recovered.

TABLE V

Class of Material	Wt. % X in T (Class Upper Limit)		Wt. % T in Mixture
A	8837203	.72	100
A	3320301	1.03	11.83
B	2293304	5.33	0.30

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The above figures are examples. It will be necessary to calculate more detailed tables for individual drum discarding.

5. Estimated Volume of Discard:

TABLE VI

Class	Class Median X-Assay Wt. %	Inventory pounds of Mix	Inventory pounds of "T"	Value of "T" dollars/ pounds	Total Value dollars	Recovery Cost dollars/ pounds	Total Recovery Cost dollars
A .75	1127502	200,000	19,000	15	285,000	4.83	966,000.
B 3.18	2251802	29,000	450	440	198,000	2.44	70,800
C 9.79	3427903	275	14	1725	24,100	—	—
D 22.08	4650803	550	1	4090	4,100	—	—
E 44.80	1598005	400	—	9110	—	—	—

The above class inventories are based on an approximate November 1, 1946 inventory. The value of "T" in each class is estimated by the median X-assay of the class upper and lower limit X-assay.

About 95% of the Class A contaminated carbon contains "T" of feed concentration or lower, and is uneconomical to recover.

The following table indicates the portion of the total contaminated carbon mixtures formed by 95% of Class A.

TABLE VII

	Pounds Mixture	No. of Drums	Pounds "T"	Ave. Wt. % X	
Class A	190,000	525	18,750	4416021	.602
All Classes	230,000	635	19,475	5526412	.641

This report reviewed and approved by the Process Materials Department Council:

F. H. Anderson
E. D. Flickinger
A. de la Garza
A. M. Tuholsky
R. W. Levin, Chairman

Prepared by:

N. Gerber
J. I. Cokin

RL/jw

~~SECRET~~

ChemRisk/Shonka Research Associates, Inc., Document Request Form

(This section to be completed by subcontractor requesting document)

J. Lamb / KP-1069 pts 1-27; pts 29-37; 39-45; 47-121 1034A

Requestor — Document Center (is requested to provide the following document)

Date of request 12/6/95 Expected receipt of document ~~1-27; pts 29-37; 39-45; 47-121~~

Document number ~~KP-1069 pts~~ PTS ~~28, 38, and 46~~ Date of document 1956-1961

Title and author (if document is unnumbered) KEM-287 PT 1

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Date request received 12/6/95

Date submitted to ADC 12/7/95

Date submitted to HSA Coordinator 12/6/95

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Date submitted to CICO 12/7/95, 1-18-96

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Date submitted to ChemRisk/Shonka and DOE 3/7/96

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Signature

REBc

2821

K/EM-287/PT1

SANITIZED VERSION OF K-304-5.8 MATERIAL RELEASE, REPORT NUMBER 251, DATED 10/15/57

(CRD DOCUMENT # KP-1069/PT28)

Compiled by
S. G. Thornton
Environmental Management Division
OAK RIDGE K-25 SITE
for the Health Studies Agreement

December 7, 1995

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7314
managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
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under Contract DE-AC05-84OR21400

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for A.L. Justus 3/1/96

Technical Information Officer — Date
Oak Ridge K-25 Site

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INTER-COMPANY CORRESPONDENCE

UNION CARBIDE NUCLEAR COMPANY

Division of Union Carbide Corporation

To: Mr. J. A. Parsons
K-303-8

Plant: Oak Ridge Gaseous Diffusion

Date: October 15, 1957

Copies To: Mr. R. H. Dyer
Mr. R. R. Frazier RC
Mr. H. G. Grisham
Mr. W. D. McCluen
Mr. H. G. P. Snyder
Production Division Files

Subject: K-304-5.8 Material Release, Report Number 251

KP-1069, Part 28

Date of Release:	August 1, 1957
Location of Release:	K-304-5.8
Balance Area Account Number:	200
Material:	UF_6
Class or Assay:	"E"
Amount of Material Involved:	One pound UF_6
Equipment:	Cell enclosure
Source of Information:	H. G. Hunter
Details:	Known loss of calculated quantity

On August 1, 1957, cell K-304-5.8 was shut down due to excessive air inleakage. During the shutdown, UF_6 escaped from the cell piping causing the contamination of the inside of the cell enclosure. The cell was evacuated and purged. A portable purging unit was connected to the cell housing and the cell enclosure purged through the alumina traps. Cascade services vacuumed and sponged with acid the inside of the cell enclosure. Two leaks were found on the expansion joint in the line between the 1A and 2B pumps. Area personnel estimated the original release at 1 lb. UF_6. Through decontamination and special accountability, a recovery of 54 grams uranium and was effected, leaving a known measured loss of 253 grams uranium which will be credited to the 200 account.

H. G. Grisham
H. G. Grisham

Classification changed to: ~~Restricted~~ CRD
(level and category)

By authority of: CG-PGD-4
(classification guide)

ADC or ADD signature (first reviewer) Date 8/12/94

ADD signature (final reviewer) Date

Approved: S. S. Stief
S. S. Stief

HGG:ag

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ChemRisk/Shonka Research Associates, Inc., Document Request Form DSR 61 2892

(This section to be completed by subcontractor requesting document)

J. Lamb / 1034A

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Date of request 6/14/96 Expected receipt of document 7/14/96

Document number KFM-27 Date of document 4/20/59

Title and author (if document is unnumbered)

(This section to be completed by Document Center)

Date request received 6/19/96

Date submitted to ADC 7/8/96

Date submitted to HSA Coordinator 6/19/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 7/8/96 8/2/96

Date received from CICO 7/31/96 8/7/96

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No. 5 of 10 copies. Series A
KFM-27

2892

Radioactive Content of the Atmosphere and Amount of Fallout

Excerpts From Classified Reports Originated at the Oak Ridge Gaseous Diffusion Plant

K-88720

KFM 27 5 A

KFM 27 5 A

Union Carbide Nuclear Company
ORGDP Records Department
April 20, 1959

K-520 - Plant Quarterly Report for First Fiscal Quarter, July 1 - September 30, 1949. Issued November 10, 1949.
Page C-10.

A release of process waste material to the atmosphere occurred on September 4 in the K-631 building. The release was caused by the fracture of a waste cylinder valve as the cylinder was being disconnected from the cascade waste withdrawal system. The cylinder was immediately removed from the building and a water fog spray was directed on the break while the leak was plugged. Decontamination of the area was effected immediately and all personnel in the area were checked at the dispensary for possible exposure. REBc

K-636 - Plant Quarterly Report for Fourth Fiscal Quarter, April 1 - June 30, 1950. Issued August 15, 1950.
Page E-13.

One large-scale material release involving radioactive materials was reported during the quarter. The release occurred at the K-1405 Chemical Development Building on June 28, 1950, and resulted from overfilling a "B" type cylinder in which a pressure build-up occurred as the cylinder was heated, with a consequent rupture releasing approximately 400 pounds of feed material. Since the cylinder was located outside the building, the side of the building and the yard area in the vicinity were contaminated. Decontamination by means of vacuum cleaning, scrubbing, earth removal and resurfacing of the yard was carried out.

K-800 - Plant Quarterly Report for First Fiscal Quarter, July 1 - September 30, 1951. Issued December 7, 1951.
Page C-16.

On August 9 a total of 12,269 grams uranium (87 grams uranium 235) was vented to the atmosphere when a small cold trap failed to remove all the uranium hexafluoride remaining in an unsuccessful reaction mixture. REBc

UNCLASSIFIED

Classification changed to: (Circle one and stamp)

ADC or ADO signature (first reviewer) Date 7/22/96

ADO (second reviewer) Date 7/30/96

This document has been approved for release to the public by: David B. Gilliland

for A.S. Quist 8/6/95
Technical Information Officer Date
Oak Ridge K-25 Site

~~SECRET~~

Union Carbide Nuclear Company, Oak Ridge Gaseous Diffusion Plant, Operating Contractor for the U.S. Atomic Energy Commission.

— DECLASSIFIED —

by authority of:

7/30/96

JF Preston, Classification Specialist

~~(CG-PGD-5) K-25 Site Classification Office~~;

(Authorized Declassifier's name and organization)

or

______________________________;

(Official declass. notice memo, TIC notice, etc.)

[signature] 7/31/96;

(Person making change (date)

[signature] 7/31/96;

(Document identification verified by) (date)

K-801 - Plant Quarterly Report for Second Fiscal Quarter, October 1 - December 31, 1951. Issued March 14, 1952.
Page C-18.

On November 17, releases occurred at 7 or 8 points in the K-27 plant and the K-631 building. While uranium hexafluoride was being condensed in one of the K-402-8 cold traps, the pressure inside the trap began to rise, indicating that the trap was nearly full. Since no other trap was available, the pressure was allowed to continue to rise. The pumps supplying these traps are equipped with overload relays set to open when the trap pressure reaches approximately 9.3 psig. However, a nitrogen line which is used to purge the trap had been inadvertently allowed to remain valved into the trap. When the trap pressure exceeded the 5 psig pressure of the nitrogen line, process gas entered the K-27 plant nitrogen header. The releases occurred wherever nitrogen from this header escaped to the atmosphere. The material in the header was purged and condensed in a cold trap.

The remaining release occurred on November 21 while light gases from a cell in the K-31 plant were being evacuated to the atmosphere through the air jets in the K-402-8 cold trap room. The gases were being transferred through the K-31 evacuation header, which had been used the previous day to remove material from a K-31 cold trap. However, the evacuation header had not been completely purged of process material. Consequently, a release of uranium hexafluoride was noticed in the K-27 area shortly after the K-402-8 air jets were placed in operation. The evacuation header was then valved off from the air jets, and the material was purged and subsequently collected in a cold trap.

K-802 - Plant Quarterly Report for Third Fiscal Quarter, January 1 - March 31, 1952. Issued June 6, 1952.
Page C-17.

The losses charged to converter decontamination in the K-1401 building were incurred when fluorine decontamination charges were vented from converters to the atmosphere. The losses are totals for 53 converters decontaminated during the quarter. These losses are based on gas samples taken from nine of the converters before the gases were vented. A cold trap system is currently being constructed and, upon completion, will be used to recover material from this operation.

Two releases occurred in the K-306-7 laboratory this quarter. The first was the result of a broken bellows in a B-4 pump. When the bellows broke, gas was released to the atmosphere for 15 minutes through the oil line and pump housing. The second leak lasted only 30 seconds and occurred when a plug was accidentally removed from a severed line during maintenance repairs.

Page C-18.

TABLE C-4
MATERIAL RELEASES

Date	Area	Known Loss Uranium Grams	Known Loss Uranium-235 Grams
January 3	K-631 Shipping Room	1,165	8
January 7	K-1303	82	0
January 16	K-413	3,665	26
February	Vault 15A	327	3
February 1	K-1413	153	1
February 2	K-1405 Uranium Hexafluoride Reduction Pilot Plant	Small and undetermined	
February 13	Vault 15A	Not yet estimated	
February 28	K-1401 Barrier Pilot Plant	2	0
January, February, March	K-1401 Converter Decontamination	8,586	67
March 1	K-306-7 Field Laboratory	Small and undetermined	
March 3	K-306-7 Field Laboratory	Small and undetermined	
March 24	Vault 15A	18	0

REBc

K-803 - Plant Quarterly Report for Fourth Fiscal Quarter, April 1 - June 30, 1952. Issued October 1, 1952.
Page C-26.

During the quarter, twelve converters were removed from K-31 and sent to K-1401 for decontamination. These converters were fluorinated at a high temperature for several hours and the recovered uranium hexafluoride vented to the atmosphere. It was calculated that 2,705 grams uranium and 19 grams uranium-235 was lost in this manner from these twelve converters. Several other converters were so treated during the quarter but, due to a lack of sample results, the loss for these operations could not be calculated. No estimate of the loss has been made.

Page C-25.

TABLE C-8
MATERIAL RELEASES

Date	Location	Known Loss Grams U	Known Loss Grams U^{235}
4-1	K-1004-A, Room 19	1,108	5
4-10	K-309-3 Test Loop	Minor, undetermined	
5-4	Vault 15-A	1	0
5-5	Vault 15-A	6	0
5-19	K-631	1,533	74
5-23	K-703 Laboratory	Minor, undetermined	
5-27	K-1401	7,668	55
6-52	K-1004-D	564	6
6-8	Vault 15-A	562	3
6-11	K-303-6 Laboratory	2	0
6-23	K-306-7 Product Withdrawal	10	9
4,5,6-52	K-1401 Converter decontamination	2,705	19

REBc

K-958 - Plant Quarterly Report for First Fiscal Quarter, July 1 - September 30, 1952. Issued February 24, 1953
Page C-12.

An estimated 1,000 pounds of uranium hexafluoride was released to the atmosphere at the K-1131 feed manufacturing plant on September 19. This material was released in order to avoid an impending explosion in the secondary cold traps of the uranium hexafluoride condensation system. An extremely high pressure had become apparent in the cold traps as these units were being heated preparatory to draining the material to one-ton chlorine-type cylinders. This high pressure was the result of hydrogen fluoride condensed with the uranium hexafluoride. It was necessary to vent the traps to atmosphere intermittently during a ten-hour period in order to hold the system pressure within safe limits.

Small material releases of uranium occurred in the K-1401 converter decontamination area. Results of four converters that were decontaminated this quarter indicate that 268 grams of uranium was vented to the atmosphere. Tabulated in table C-6 are the material releases.

TABLE C-6
MATERIAL RELEASES

Date	Location	Loss	
		Grams U	Grams U-235
7-18	Vault 16A	960	7
9-9	K-131	Undetermined	Undetermined
9-19	K-1131	306,718	2,182
7,8,9-52	K-1401 Converter Decontamination	268	3

K-959 - Plant Quarterly Report for Second Fiscal Quarter, October 1 - December 31, 1952. Issued June 1, 1953.
Page C-12.

On December 30, the valve gland nut on a Paducah product cylinder failed while the cylinder was being sampled in the K-402-1 feed station. A total of 2,506 pounds of uranium hexafluoride (all but 200 pounds of the cylinder's contents) was released, contaminating all of Building K-27 to varying degrees. Most of the material was deposited in Units K-402-1, K-402-2, and K-402-3, but all units in the building were affected since the gas was spread widely before the ventilating system could be shut down.

TABLE C-4
MATERIAL RELEASES

REB
Wrong amounts in list

Date	Location	Loss Grams U	Loss Grams U-235
10-3	K-631	15,335	69
10-10	K-631	4,600	20
10-13	K-402-6	613	3
10-31	K-1401	Small, undetermined	
11-3	K-413	3,067	14
11-21	K-306-7	307	1
12-3 to 12-10	K-1301	1,626	7
12-24	K-306-7	920	4
12-29	K-306-7	1,534	7
12-30	K-402-1	768,590	4,312
12-30	K-306-7	6,134	29
10-1 to 12-31	K-1401 Converter Decontamination	3,710	34
Totals		806,436	4,500

K-960 - Plant Quarterly Report for Third Fiscal Quarter, January 1 - March 31, 1953. Issued July 3, 1953.
Page C-11.

On January 8, 1953, approximately 193 pounds of uranium hexafluoride was released to the atmosphere from a Paducah product cylinder. The release resulted from a valve-gasket failure on the cylinder while the cylinder was being heated in the steam bath of Building K-131.

REB
An estimated 0.28 pounds of uranium hexafluoride was lost to the atmosphere from the 20-stage pilot plant.

TABLE C-7
MATERIAL RELEASES

Date	Location	Loss Grams U	Loss Grams U-235
1-8-53	K-131	59,193	473.5
1-13-53	K-631	138,015	793.6
1-30-53	K-1401	86	0.6
1-1 to 3-31-53	K-1401 compressor and converter decontamination	29,913	353.0
Totals		227,207	1,620.7

K-961 - K-25 Plant Quarterly Report for Fourth Fiscal Quarter, April 1, thru June 30, 1953. Issued August 6, 1953.
Page C-11.

On April 15, approximately 5 pounds of uranium hexafluoride was released to the atmosphere at Building K-631. The release resulted from a load bearing failure on the high-speed centrifugal compressor, requiring replacement of the compressor.

On May 25, two cylinders containing uranium hexafluoride were being heated in the K-413 water bath prior to transfer of the contents to a large cylinder. One of the cylinders began rising in the bath and the operators immediately left the room. The cylinder exploded and the entire contents (123 pounds of uranium hexafluoride) were released to the atmosphere.

REBc

A cylinder containing Hanford tails material was being sampled when the packing gland nut on the valve broke and 952 pounds of uranium hexafluoride were released, 75 pounds of which were recovered by decontamination.

TABLE C-8
Material Releases

Date	Location	Loss	
		Grams U	Grams U235
April 15	K-631	1,534	10
May 1	K-631	15,336	100
May 25	K-413	37,849	269
June 1	K-1131	269,143	1,790
April 1 to June 30	Equipment Decontamination	12,630	262
Total		336,492	2,431

K-1050 - K-25 Plant Quarterly Report for First Fiscal Quarter, July 1, thru September 30, 1953. Issued November 4, 1953.
Page C-13.

Two materials releases occurred in the K-27 building this quarter. The first incident involved the loss of 75 pounds of process gas. On September 6, a cylinder was being heated in Unit K-402-4 prior to sampling when the contained material vaporized and escaped through an open valve. The other release occurred in Unit K-402-8 on September 30. Material was being cold trapped when a large demand for refrigerant in Building K-1131 caused the cold trap to become warm. The process gas passed through the cold trap to the atmosphere. Almost 100 pounds of material was vented from the system.

A small aluminum cylinder ruptured in Building K-1401 on September 9. A plug developed in the discharge line beyond the cylinder valve and continued heating built up sufficient pressure to rupture the cylinder and release 18 pounds of process gas to the atmosphere.

Page C-13,

TABLE C-8
Material Release

Date	Location	Loss Grams U	Loss Grams U235
7-18	Vault 16A	78	2.2
8-2	K-413	5,000	40.0
8-13	K-1131	300	2.4
9-6	K-402-4	23,003	163.7
9-7	K-131	3,067	36.8
9-9	K-1401	5,521	39.3
9-13	Vault 6A	14,156	95.0
9-30	K-402-8	29,730	262.2
7-1 to 9-30	K-1401 Equipment Decontamination	3,512	66.0
Totals		84,367	707.6

REBc

K-1051 - K-25 Plant Quarterly Report for Second Fiscal Quarter, October 1, thru December 31, 1953. Issued February 12, 1954.
Pages C-9 & 10,

Five process gas releases took place during this quarter as well as several material releases. The material releases occurred in Vaults 15A and 16A when drums containing uranium solutions corroded, allowing the contents to spill.

A small uranium hexafluoride release occurred on October 23 in Unit K-312-3. This occurred when material being evacuated from Cell 13 overloaded the alumina traps, allowing approximately 51 grams of uranium to escape to the atmosphere.

On October 30, fifty pounds of uranium hexafluoride was released to the atmosphere at the K-1131 feed manufacturing plant. This was caused by a deficiency of refrigerant in the secondary cold traps. The traps became warm, allowing uranium hexafluoride to vaporize and escape to the atmosphere through the vent system.

A release took place in Building K-1131 on December 19 when a gasket failed in the uranium hexafluoride drain line. Ten pounds of uranium hexafluoride was released to the atmosphere. Another uranium hexafluoride release took place in Building K-1131 on December 22. Seven pounds of uranium hexafluoride was lost when the pressure in the fluorine scrubber increased due to a restriction in the outlet lines. This material was released to the atmosphere at the feed hopper.

The last release which occurred during this quarter took place on December 29 in Building K-101. A sight glass broke and about ten pounds of uranium hexafluoride escaped to the tower housing. The sight glass was immediately valved off and replaced. Subsequently, the uranium hexafluoride in the tower housing was evacuated via alumina traps. Table C-8 shows the dates, location, and amounts of uranium and uranium-235 lost in conjunction with each process gas release.

Page C-10, (Cont'd)

Also shown are the amounts of material lost in Vaults 15A and 16A and in Building K-1401 during converter decontamination.

TABLE C-8
Material Releases

Date	Location	Loss Grams U	Loss Grams U-235
10-23	K-312-3	51	0.3
10-30	K-1131	15,335	102.7
12-19	K-1131	3,067	21.9
12-22	K-1131	2,147	15.0
12-29	K-101	3,067	662.5
10-1 to 12-31	Vault 15A	3,288	22.0
10-1 to 12-31	Vault 16A	7,339	61.4
10-1 to 12-31	K-1401 Equipment Decontamination	1,330	27.8
Total		35,624	913.6

K-1052 - K-25 Plant Quarterly Report for Third Fiscal Quarter, January 1, thru March 31, 1954. Issued May 3, 1954
Page C-12,

TABLE C-9
Material Releases

Date	Location	Loss Grams U	Loss Grams U-235
1-5-54	Vault 15A	784	5
2-12-54	K-131	1,534	23
3-8-54	Vault 15A	3,149	21
	Vault 17A	58	3
3-30-54	Vault 17A	400	3
1-1-54 to 3-31-54	Vault 16A*	22,047	184
1-1-54 to 3-31-54	K-1401 Equipment Decontamination	8,325	320
Total		36,297	559

*This consisted of 10 separate releases.

K-1053 - K-25 Plant Quarterly Report for Fourth Fiscal Quarter, April 1, thru June 30, 1954. Issued August 24, 1954
Page C-10,

Five process gas releases occurred during the fourth quarter of fiscal year 1954. Two of these releases occurred at K-306-7, one in the product purification unit and one at the product sample line. The former occurred on June 11 and about 0.5 ounces of process gas was lost. The latter took place on June 30 and approximately 4.5 ounces was lost. About 50 pounds of process gas was lost at K-633 during the month of June. This was caused by a partial plug in a faulty valve and the release occurred when the valve was removed. On June 15, 2.2 pounds of process gas was released to the atmosphere from the 20-stage pilot plant. Approximately 1.7 ounces of process gas was lost in D Laboratory on June 29 due to a faulty thermowell on a product sample cylinder.

Page C-10, (Cont'd)

Table C-6 shows the dates, locations, and amounts of both uranium and Uranium-235 of the above releases. Also shown are material releases from eight storage drum leaks.

TABLE C-6
Material Releases

Date	Location	Loss	
		Grams U	Grams U-235
5-5	K-131	55,987	418
4-6	Vault 16A	207	5
4-10	K-1410	129	5
4-13	Vault 16A	406	8
4-18	K-1303	1,198	11
5-11	Vault 16A	966	13
5-26	Vault 16A	8	0
6-11	K-306-7	10	9
6-15	K-1401	1,000	7
6-29	D Laboratory	53	49
6-30	K-306-7	128	119
6-1 to 6-30	K-633	15,336	101
Total		75,428	745

REBc

K-1150 - K-25 Plant Quarterly Report for First Fiscal Quarter, July 1, thru September 30, 1954. Issued November 15, 1954
Page C-12,

TABLE C-8
Material Releases

Date	Location	Loss	
		Grams U	Grams U-235
August 2	K-1401	500	4
August 16	Vault 16A	52	2
August 30	K-631	3,067	22
Apr. 1 thru Sept.30*	K-1401 Decontamination	10,855	315
Total		14,474	343

* This includes the values for the fourth quarter of fiscal year 1954.

REBc

K-1151 - K-25 Plant Quarterly Report for Second Fiscal Quarter, October 1 thru December 31, 1954. Issued February 15, 1955.
Page C-11.

"...release was incurred in the pilot plant laboratory on October 10. About 5 to 10 pounds of uranium hexafluoride was released to the atmosphere when a seal failed on a high pressure purge cell. ..... Also included ... is material vented at K-1131 during November."

TABLE C-6

MATERIAL RELEASES

Date	Location	Loss	
		Grams U	Grams U-235
October 10	K-1004-L	3,067	20
October 14	K-306-7.10	101	94
October 14	Vault 16A	164	8
November 8	Vault 16A	274	6
November 1-29	K-1131	22,415	150
December 12	Product Purification Unit	34	32
December 22	K-413	3,067	40
October 1 through December 1, '54 Total	K-1401 Decontamination	815	40
		29,937	390

K-1152 - K-25 Plant Quarterly Report for Third Fiscal Quarter, January 1, 1955 thru March 31, 1955. Issued May 11, 1955.
Page C-12.

TABLE C-6

MATERIAL RELEASES

Date	Location	Loss	
		Grams U	Grams U-235
January 6, 1955	Vault 16A	462	6
January 21	Product Purification Unit	28	26
March 10	K-33 Feed Room*	144,815	1,028
March 16	K-631	3,012	15
January 1 through March 31, 1955 Total	K-1401 Decontamination	2,988	82
		151,305	1,157

*This includes both releases.

K-1250 - ORGDP Quarterly Report for First Fiscal Quarter, July 1, 1955 thru September 30, 1955. Issued November 23, 1955.
Page C-12.

Two process gas releases occurred during the first quarter of fiscal year 1956, the same as during the preceding quarter. On August 31, 0.5 pounds of uranium hexafluoride were released to the atmosphere. The release occurred during evacuation of cell K-301-1.4 while utilizing portable air jets. Approximately 2.8 kilograms of uranium were piped to the holding pond from the K-1420 No. 2 rinse subsequent to decontamination of converter No. 000-496 on September 12.

Table C-9 summarizes the dates, locations, and weights of uranium and uranium-235 lost in the above releases. Also included are the materials vented during feed plant operation (building K-1131), the materials vented during converter decontamination (building K-1401), and the materials spilled due to corroded drums (vaults Nos. 15A and 16A).

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TABLE C-9
MATERIAL RELEASES

REBc

Date	Location	Loss	
		Grams U	Grams U-235
August 31, 1955	K-301-1.4	153	23
September 12	K-1420	2,756	12
September 28	Vault 15A	2	0
	Vault 16A	124	29
July 10 through September 30	K-1131 Stack losses	20,982	141
July 1 through September 30	K-1401 Decontamination	120	2
	Total	24,137	207

K-1251 - ORGDP Quarterly Report for Second Fiscal Quarter, October 1, 1955 thru December 31, 1955. Issued February 15, 1956.
Page C-12.

Eight process gas releases occurred during the second quarter of fiscal year 1956. On October 13, a sample tube ruptured releasing 35 grams of uranium hexafluoride in the barrier research laboratory. Six pounds of process gas was released on October 30 in the K-33 feed room due to a leaky cylinder valve. A corroded container permitted about two pounds of uranium hexafluoride to be released in K-1410 on October 31. On November 8, 10 pounds of reactor tails material was released in K-1131 due to a leak in the clean-up reactor. About 100 grams of top product material was released on December 4 in the K-306-7 product purification unit when a valve bellows ruptured. Two process gas releases of insignificant amounts occurred in K-413 on December 20 and 24 during Beach-Russ pump replacements. On December 26, 7 pounds of uranium hexafluoride was released to the atmosphere outside of building K-413. This release was caused by a leaky valve on a special withdrawal cylinder containing 1.44 assay material.

Page C-13.

Table C-8 summarizes the dates, locations, and weights of uranium and uranium-235 lost in the above releases. Also included are the amounts of material vented during feed plant operation (building K-1131) and the amounts of material spilled due to corroded drums (vaults Nos. 15A and 16A).

TABLE C-8
MATERIAL RELEASES

Date	Location	Amount Released, Grams	
		Uranium	Uranium-235
October 13, 1955	K-1401	24	1
October 30, 1955	K-33 Feed Room	1,840	14
October 31, 1955	K-1410	663	12
November 8, 1955	K-1131	3,067	20
November 20, 1955	Vault 16A	1,555	54
November 30, 1955	Vault 15A	1	1
December 4, 1955	K-306-7 PPU	100	93
December 14, 1955	Vault 16A	9,117	63
December 20, 1955	K-413	*	*
December 24, 1955	K-413	*	*
December 26, 1955	K-413	2,147	31
October 1 through December 31, 1955	K-1131 (Feed Plant)	40,819	274
Total		59,333	563

* A small unmeasurable amount of process gas was released during pump changes.

K-1252 - ORGDP Quarterly Report for Third Fiscal Quarter, January 1, 1956 thru March 31, 1956. Issued May 23, 1956.
Page C-14.

TABLE C-8
MATERIAL RELEASES

Date	Location	Amount Released, Grams	
		Uranium	Uranium-235
1-20-56	K-33 Feed Room	1,534	12
1-31-56	Vaults 15A and 16A	36,685	247
1 - 56	K-1131 (Feed Plant)	12,471	66
2 - 56	K-1131 (Feed Plant)	14,410	97
3-26-56	Vault 16A	142	29
3-31-56	Vault 26A	9	8
3 - 56	K-1131 (Feed Plant)	11,980	80
		77,231	539

K-1253 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for Fourth Fiscal Quarter, April 1, 1956 thru June 30, 1956. Issued August 23, 1956. Page C-12.

Only one process gas release occurred during the fourth quarter of fiscal year 1956. On May 6, the gasket on a feed cylinder valve failed and 5 pounds of process gas were released to the atmosphere. The cylinder contained depleted material which was being fed to the K-633 test loop.

Several material releases occurred in vaults 15A and 16A and were attributed to corroded drums. The amounts are shown in table C-8, with the associated dates referring to the dates of discovery rather than to the dates of the actual releases.

Table C-8 shows the dates and locations of all material releases experienced during the fourth quarter, as well as the equivalent amounts of uranium and uranium-235. Also shown are the monthly amounts of material vented during normal operation of the feed plant (K-1131). In this manner, 69,984 kilograms of uranium as uranium hexafluoride, at an approximate assay of 0.67%, were vented during the quarter.

REB

TABLE C-8

MATERIAL RELEASES

Date	Location	Amount Released, Grams	
		Uranium	Uranium-235
April 4, 1956	Vault 15A	1,734	14
April 9	Vault 15A	2,571	22
April 9	Vault 16A	18,066	475
April 12	Vault 16A	6	5
May 6	K-633 Test Loop	1,534	5
May 31	Vault 15A	1,286	11
April, May and June	K-1131 (Feed Plant)	69,984	472
Total		95,181	1,004

K-1350 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for First Fiscal Quarter, July 1, 1956 thru September 30, 1956. Issued December 4, 1956. Page C-11.

Three uranium releases occurred during the first quarter of fiscal year 1957. The first such release occurred in building K-1131 on August 31 when a pump discharge gasket failed, releasing approximately 67.6 pounds of uranium to the atmosphere.

On September 20, a plug in a cylinder was ejected during recovery operations in building K-601, releasing approximately 10 pounds of uranium.

The rupture of a Hoke valve diaphragm released 0.496 pounds of uranium at building K-1024 on October 1. The rupture was caused by excessive vibration. No material releases were reported for the vaults during this quarter.

Table C-8 shows the dates and locations of all material releases experienced during the first quarter, as well as the amounts of uranium and uranium-235 which were released. Also shown are the monthly amounts of material vented during normal operation of the feed plant (K-1131). In this manner, 82.429 kilograms of uranium as uranium hexafluoride, at an average assay of 0.47%, was vented during the quarter.

TABLE C-8

MATERIAL RELEASES

Date	Location	Amount Released, Grams	
		Uranium	Uranium-235
August 31, 1956	K-1131	30,672	92
September 20, 1956	K-601	4,673	33
October 1, 1956	K-1024	224	1
July, August, September	K-1131 (Feed Plant)	82,429	386
Total		117,998	512

K-1351 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for Second Fiscal Quarter, October 1, 1956 thru December 31, 1956. Issued February 28, 1957. Page C-11.

TABLE C-7

MATERIAL RELEASES

Date	Location	Amount Released, Grams: Uranium	Amount Released, Grams: Uranium-235
October 1, 1956	K-1024	224	1
October, 1956	K-1131	7,036	47
November, 1956	K-1131	4,439	30
*December 12, 1956	Vaults 15-A, 16-A, and 17-A	40,705	670
December, 1956	K-1131	14,148	95
Totals		66,552	843

*This was the date when the vaults were inventoried and the drums found to be empty. The contents had leaked out over a period of time while in storage.

K-1352 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for Third Fiscal Quarter, January 1, 1957 thru March 31, 1957. Issued May 31, 1957. Page C-12.

TABLE C-8

MATERIAL RELEASES

Date	Location	Amount Released, Grams: Uranium	Amount Released, Grams: Uranium-235
January 7, 1957	K-1131	1,840	12
January 23, 1957	Vaults 15-A and 16-A	48	5
January, 1957	K-1131	10,041	67
February 4, 1957	K-1131	Negligible	-
February 22, 1957	K-1131	1,534	10
February 28, 1957	Vault 15-A	546	159
February, 1957	K-1131	11,336	76
March, 1957	K-1131	26,545	111
Totals		51,890	440

K-1353 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for Fourth Fiscal Quarter, April 1, 1957 thru June 30, 1957. Issued August 30, 1957. Page C-10.

TABLE C-8
MATERIAL RELEASES, K-1131

REBc

Month	Amount Released, Grams	
	Uranium	Uranium-235
April, 1957	34,451	120
May, 1957	35,098	231
June, 1957	54,547	381
Total	124,096	732

K-1360 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for First Fiscal Quarter, July 1, 1957 thru September 30, 1957. Issued December 2, 1957. Page C-19.

TABLE C-15
MATERIAL RELEASES

REBc

Date	Location	Amount Released, Grams	
		Uranium	Uranium-235
July, 1957	K-1131	47,429	320
1953 - 1957	Vault 16-A	285	2
August, 1957	K-1131	20,651	140
September, 1957	K-1131	5,079	34
August 1, 1957	K-304-5. 8	253	183
Total		73,697	679

K-1361 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for Second Fiscal Quarter, October 1, 1957 thru December 31, 1957. Issued March 11, 1958. Page C-19.

REBc

TABLE C-14
MATERIAL RELEASES

Date	Location	Amount Released, Grams	
		Uranium	Uranium-235
10-10-57	K-413	3,041	46
10-28-57	K-1131	-	-
10-57	K-1131 Vent	14,740	103
11-21-57	K-1131	-	-
11-26-57	K-631	307	1
11-57	K-1131 Vent	23,409	167
12-57	K-1131 Vent	18,588	126
Total		60,085	443
% Change from Previous Quarter		-18.5	-34.8

K-1362 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for Third Quarter Fiscal Year 1958, January 1, 1958 thru March 31, 1958. Issued May 21, 1958. Page C-19.

TABLE C-16

MATERIAL RELEASES

Date	Location	Amount Released, Grams Uranium	Uranium-235
1-58	K-1131 Vent	36,147	257
1-12-58	K-33 Feed Room	4,601	33
1-13-58	K-902-4.2	307	4
1-24-58	K-631	4,601	18
2-58	K-1131 Vent	30,752	215
3-58	K-1131 Vent	20,811	148
3-20-58	K-33 Feed Room	22,084	157
Total		119,303	832
% Change from Previous Quarter		+98.6	+87.8

K-1363 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for Fourth Quarter Fiscal Year 1958, April 1, 1958 thru June 30, 1958. Issued September 9, 1958. Page C-19

TABLE C-15

MATERIAL RELEASES

Date	Location	Amount Released, Grams Uranium	Uranium-235
April, 1958	K-1131 Vent Stack	25,087	176
May, 1958	K-1131 Vent Stack	24,329	166
May 6, 1958	Vaults 15-A, 16-A, 17-A	271	6
June, 1958	K-1131 Vent Stack	19,771	137
June 25, 1958	K-402-3.6	205	21
Total		69,663	506
% Change from previous quarter		-41.6	-39.2

K-1410 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for First Quarter Fiscal Year 1959, July 1, 1958 thru September 30, 1958. Issued 12/22/58. Page C-17.

TABLE C-17

MATERIAL RELEASES

REB

Date	Location	Amount Released, Grams	
		Uranium	Uranium-235
September 2, 1958	K-1004-L	7,666	51
September 3, 1958	K-631	307	1
September 11, 1958	K-1004-A	705	3
July, 1958	Storage Vault	68	0
July, 1958	K-1131 Vent	40,527	288
August, 1958	K-1131 Vent	58,854	407
September, 1958	K-1131 Vent	54,326	387
Total		162,453	1,137
% Change from Previous Quarter		+133.2	+124.7

K-1411 - Oak Ridge Gaseous Diffusion Plant Quarterly Report for Second Quarter Fiscal Year 1959, October 1, 1958 thru December 31, 1958. Issued 3/31/59. Page C-17.

TABLE C-16

MATERIAL RELEASES

REB

Date	Location	Amount Released, Grams	
		Uranium	Uranium-235
October, 1958	K-1131	31,109	217
November, 1958	K-1131	25,794	182
December, 1958	K-1131	31,034	221
Total		87,937	620
% Change from Previous Quarter		-45.9	-45.5

KD-1572, Part 2 - Plant Engineering Development Progress Report for Second Fiscal Quarter, October 1, 1958 thru December 31, 1958. Issued 2/20/59. Page 36.

MONITOR FOR AIRBORNE URANIUM DUST - ESO D-38656

A development model of an alpha air monitor, designed for a rapid indication of high level uranium dust concentrations, has been fabricated and installed in the K-601 building for testing and to obtain data on the variations in natural radon daughter product background. This instrument is intended as a supplement to the present air monitors which detect low uranium dust concentrations (less than the plant allowable limit), but which require a four and one-half hour time delay between sample collection and analysis to allow for decay of the natural background.

Since the reading of this new gross release air monitor includes the short half-lived natural alpha radiation along with the long half-lived uranium alpha radiation and since the natural radiation varies greatly from day to day and even from hour to hour, this instrument does not furnish a very accurate indication of the amount of airborne uranium present. The instrument is designed to provide an alarm when the over-all radiation level exceeds a preset value. This alarm point has to be set so that it is above the highest level normally reached by the background radiation and it is anticipated that an alarm set point of twenty times the plant allowable limit will be sufficient to prevent most erroneous alarms. From the information available, the natural background can be expected to vary between a low of 2 P.A.L. (plant allowable limit) and a high of 18 P.A.L.

Field tests are presently being performed adjacent to an instrument that samples for one-half hour and analyzes after a four and one-half hour delay and the data from the two monitors are being compared.

Thus, a release of 18 times the plant allowable limit, when a natural background of 2 P.A.L. exists, will be required to actuate the alarm. However, when the natural background is at the high value of 18 P.A.L., a release of only two P.A.L. would actuate the alarm. It is believed that conditions which produce natural backgrounds above 20 P.A.L. will happen so seldom that the false alarms will be of little consequence; however, field tests will be performed to determine if an alarm point of 20 P.A.L. will be reasonable for this application.

This Alpha Air Monitor consists of a type F-1 continuous air monitor that has been altered to permit the sampling of 75 cu. ft. of air in five minutes time, analyze the collected dust sample for alpha radiation, and sound an alarm when the radiation level is above a preset value. The principal components of the instrument are shown diagramatically in Figure 13 and Figure 14. The system includes an intermittent filter paper drive controlled by timers and relays, an enlarged sampling head with Staplex Type TFIA pump, a five inch scintillation detector, and a count rate meter with associated alarm circuit. The air-sampling pump creates an air flow through the filter paper of 15 cu. ft. per minute. At the end of the sampling period, the timers stop the pump and allow six seconds for relief of the vacuum in the sampling head. The filter paper drive assembly then moves the collected dust sample from the sampling area to the scintillation

detector. A cam on the paper drive shaft actuates a microswitch which stops the sample under the detector and initiates a new cycle. The counting of the sample and the collection of a new sample proceed concurrently.

The electronic system for the instrument shown in block diagram in Figure 14 was obtained by altering a standard Poppy Radiation Meter. A contact making meter was added to the panel to provide an adjustable alarm. The recorder has been added to the development model to provide a convenient means of recording field test data.

Plant Engineering Monthly Progress Report, April 1, 1959

ALPHA AIR SAMPLER - ESO D-38656

An experimental model of the Fixed Filter Paper Type Alpha Air Monitor was operated last month at K-601 to obtain comparative data on the instruments response to diurnal background variations and small releases of uranium hexafluoride gas. This data was required before a rate sensitive electronic alarm circuit for the instrument could be designed. Data obtained thus far indicate that an instrument of this type will function as a gross release detector provided a satisfactory alarm circuit can be designed.

A graph that summarizes the background and uranium hexafluoride release data has been compiled. The diurnal background variations range from a low of one P.A.L. to a high of 26 P.A.L. However, uranium hexafluoride releases that were recorded by the 4-1/2 hour delay continuous Air Monitor as 8 P.A.L. could be distinguished from the fastest background changes by visible inspection of the recorder chart. Efforts will be directed toward designing a rate sensitive electronic circuit that will discriminate between a rapid background change and a uranium hexafluoride release. This circuit will then be used to actuate an alarm when the rate of change exceeds a preset limit.

Three types of filters have been tested in an effort to improve operating characteristics. The Millipore Type AA filter plugs less in a dusty atmosphere than other type filters that have been tried. There is also some evidence that this type filter may also reduce background fluctuations. This probably results from its ability to collect smaller dust particles which pass through other filters. Additional information will be required before definite conclusions can be drawn.

A second instrument of the fixed filter paper type is being constructed. By properly locating the two instruments and operating them concurrently, it will be possible to compare background variations inside and outside process buildings. It is anticipated that the background variations will agree closely. If this is found to be true, it may be possible to use background information from a remotely located instrument that is not subjected to uranium dust to correct for background variations of gross release instruments. Efforts will be made to have the second instrument ready for operation by the end of April.